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ELECTRIC RAILWAY ENGINEERING.

CONSIDERING the rapidity with which electric railways were constructed, and the almost entire absence of precedent and experience, it is not to be wondered at that breakdowns on American lines have been frequent and repair bills in many cases rather heavy. During the great "boom" it was necessary to get through the work quickly, in order to satisfy the enormous demand upon two or three companies then in existence, none of which had much practical experience in railway work. New men had to be trained in the space of a few weeks, and sometimes only days, to take charge of the entire plant and equipment of a tram line, taxing to the utmost the mental and physical resources of both the trained and the trainers.

It speaks well of the indomitable energy and perseverance of Americans that they have been able, under most trying circumstances, to keep up a good reputation for electric traction—in fact, to lay the foundation for a gigantic new industry. It was not to be wondered at that motors, gearing, switches, lines, and insulation broke down with frequency, but the surprising part was that the men in charge did not break down themselves. Many a man possessed of self-esteem, and sufficient regard for the reputation of his employers, could tell of anxious days and wearisome nights devoted to hasty repairs, discovery of defects, and schemes for remedies. These men had a complex set of duties and cares. Besides keeping things going with the outward appearance as if nothing had happened, whilst hourly accidents did occur, they endeavoured to show that electric traction is not only better, but also cheaper than any other kind of traction. The eyes of the sceptical public were ever upon them; their work was eminently a public one, and well they did it so far. One by one improvements were suggested and acted upon, and we can see by recent publications that they are not now afraid to discuss publicly certain defects, with a view of getting suggestions for remedies. Rules and specifications are being framed for purposes of future work, with the express purpose of avoiding all the past errors and thus to insure permanent success.

The "General Instructions for Overhead Line Construction for Electric Railways," issued by the Westinghouse Electric Manufacturing Company are a timely and sensible innovation, which deserve imitation in other branches of this industry. We shall reprint these, feeling certain that they will interest those readers who follow up the progress of electric traction. The methods of connecting ground wires, the best kinds of poles and how to plant them, together with overhead wires and fixtures are fully described. No doubt there are differences of opinion as to the best methods of doing these things, but if these rules are followed, little difficulty should be experienced in maintaining the line in good working condition. Perhaps at some future date other firms with large experience will frame rules or instructions for the proper construction and maintenance of other equally, if not more important, parts of electric railways, especially with details appertaining to the cars themselves.

THE TAIL OF A LAME FOX.

(Very much after Æsop.)

A MODERN fabulist, who, until now, has evidently mistaken his vocation in life, has sent us the following:—

Once upon a time, an old Farmer named Moses Gee was walking in his poultry-yard, when he overheard an animated discussion between a goose, a Swan, and a Fox, as to the ownership of some eggs. The goose said they were hers, because they were golden; the Swan said they were hers becausd they glowed so brightly; and the Fox said they were his because they were laid on the ground, and as he owned the "earth" they must be his. But the birds replied, "We live on the water, in the old dam, and the neighbouring streams,

and, though you may claim the earth, that has nothing to do with us." "Oh!" said the Fox, triumphantly, "my family has burrowed for years in the ground, and currents of water now run through these tunnels into the reservoir that I first thought of." "But did you make the reservoir? And what about the old pump that feeds the reservoir—is that yours also?" "Well—yes—nearly," said the Fox, "For, as I claim the earth, surely the streams, and the dam, and the pump must be mine." The birds were silent; but a small, newly-fledged Drake came forward, and said he believed the Fox was right, for he knew much about reservoirs. He had been nearly choked in one, there was so much mud and weeds, and he would have been drowned had not a kindly frost come and frozen the water. This pleased the Fox, and he whispered something to the Drake about giving him part of the earth, when he got it. The Farmer, who heard all this, now noticed for the first time that the Fox was Lame and had lost his Brush. The Fox, observing this, seemed embarrassed, and said, "I know I am a poor Lame-Fox, and have lost my Brush, but in this you ought to pity me." The Farmer replied, "I would have pitied you, but for the arrogant claims you made just now. But where did you lose your tail?" The Fox sighed, and said something about his Webb-footed friends, who had made a Sell-on him. Here he became pensive; then looked angrily at the goose and the Swan, and said he had nearly learned to lay eggs himself once, light ones that would float in the currents from the reservoir. "Oh!" said the birds, "The idea of a fox laying eggs. Why, we could not lay such nice ones but for our vegetable diet of bamboo and cotton seed, and a Fox cannot eat that." At the mention of eating, the Fox looked hungrily at the little Drake, who ran away, saying he did not want to be eaten, and the Fox might keep his "earth" to himself. There was then a great commotion in the farmyard, and Moses Gee, the farmer, said, "Birds, go on and lay your eggs. The Fox is Lame. He cannot hurt you: and as to his claim, all the farm, and stream, and reservoir, were mine before any of you were born, and you are all free to do as you please." At this the Fox ran away, and they all lived happily ever after.

THE CENTRAL STATION AS AN INVESTMENT.

IT is evident that the electric lighting business has taken a firm hold as an industry of the world, and that the supply of current for motive purposes will be in increasing demand. Even in this country, the requirements of the public have outgrown the power of private firms to deal with, so that it has been imperative to form large corporations with immense capital to grapple with the task. Central stations have been erected and fitted in many parts of London, from whence the demand for the electric current can be met. Districts have been assigned to the supply companies, and the town mapped out in a similar manner to what existed formerly with the various gas companies, before these latter were consolidated into two huge corporations. The question now arises, Will these stations pay? According to Mr. B. E. Sunny (who read a paper before the Chicago Electric Club meeting on October 20th last), that will depend on good engineering, as the whole secret of dividend-paying enterprises is in their ability to run reliably, every day and every year, without subjecting the machinery to excessive and abnormal demands, and in the avoidance of rebuilding, or abandoning original investments. The plant up to the point of normal and safe output should be fully employed, as well by day as by night; it is the duty of the management, therefore, to endeavour to utilise the machinery during the day in driving motors or charging accumulators, or in any other way that will bring grist to the mill; further the price at which the electric current can be produced, and that at which it can be sold, leave a margin of profit that ought to be satisfactory.

Now, commercially, the business may be considered a success, from the fact that it is ever increasing. How then does its record read from the investor's standpoint? Can it be reckoned on the same footing with gas-works, water-works, or railways as a dividend producer? Most decidedly it can, and perhaps no people recognise the future of electric lighting more than the gas companies themselves. The American *Gas Directory* states that the gas companies are operating 32,000 arc lights and 140,000 incandescents. In one year these companies have increased their ownership in electric lights nearly 50 per cent., thus showing their belief in the earning power and permanency of the electric light. Hitherto, the ratio of expansion of business has been put much too low; in consequence, stations have been built on far too small a scale, necessitating, after perhaps only a couple of years, an entire reconstruction of premises and plant to meet the ever-growing demand for electric lighting. Cheap and scratch plants will never pay a dividend in the long run. To be profitable, an installation should be furnished with standard types of engines, dynamos, and apparatus that are not likely to become old-fashioned for many years to come.

By not, at the outset, building a station on a plot of sufficient area, as patrons increase the plant has to be added to until the place is crammed in every corner with a perfect chaos of machinery, and presents what Mr. Sunny concisely calls an exhibition of engineering gymnastics. This kind of station is a financial success, working always at its maximum output, until the demand exceeds the supply, and it becomes necessary to rebuild. The rebuilding means, in many cases, selling off the old machinery at an enormous sacrifice, and the complete loss of all investment in foundations, &c. To prevent such loss in the future, would it not be better to build the majority of central stations on such a scale as will meet the anticipated requirements of electric supply at the end of 20 or 30 years?

Mechanical Engineering on Electric Tramways.

Mr. A. RECKENZAUN'S paper on "Electric Locomotion," read before the Society of Arts in April, 1887, was probably the most complete *exposé* of the state of the art at that date; therein the subject was considered mostly from a mechanical engineer's standpoint, great care being taken in revealing the advantages or disadvantages of certain mechanical details. It was shown that the spur gearing on certain continental electric cars had worn out in a remarkably short space of time, and that the engineers attached to these lines were puzzling their brains over the best forms of gearing for electric cars. Six months later Mr. Reckenzaun read another paper entitled "Electric street cars, with special reference to methods of gearing," before the American Institute of Electrical Engineers, which evoked an interesting discussion and a variety of opinions. That the problem of the mechanical transmission of power between the motor and axle of a tramcar is still a long way off its solution is evidenced by the report of Dr. W. L. Allen presented to the recent Convention at Buffalo. On four Sprague cars, each running 90 miles a day, there were worn out, within six months ending October 1st, 1890, 14 pinions, 6 spur wheels and 26 bearings of various kinds. On one of the Thomson-Houston electric railways, running 150 to 200 cars there occurred 158 cases of disablement, from purely mechanical reasons, during 14 consecutive days. This would point to the fact that mechanical engineering on electric railways offers a wide field for research and improvement. There are, on an average, six cars disabled mechanically to one electrically. Altogether, the figures are appalling, and we do not wonder that Messrs. Mather & Platt preferred to drive the axles of the City and South London locomotives direct, although, in this case, difficulties of another kind may become apparent, since the acute vibrations of the driving axles are communicated direct to the armature. In the case of tramcars it is most difficult to apply motors of sufficiently slow speed, and gearing of some sort has to be used.

Industrialism.

IN Mr. Esson's presidential address on Industrialism to the Old Students' Association, our readers will find a very able and interesting historical sketch of this important subject from the earliest to the present time. He makes a vigorous onslaught on socialism, State or other; and expresses a decided opinion that what is best in our industrial system is the result of individual effort. His statement, based on personal experience, that the working classes in this country spend from 15 to 20 per cent. of their earnings on beer and tobacco, gives one a somewhat startling idea of the improvidence of the British workman. We think, however, that Mr. Esson overestimates the effect of Poor Laws in encouraging improvidence, since, according to recent statistics, considerably less than one-tenth of the poorest class in London avail themselves of State relief. Mr. Esson thinks that all changes in our industrial system are the result of evolution; the present system with all its defects being the best that the average human nature is capable of. With many other of our most advanced thinkers on this question, he looks upon co-operation as the goal to which we are tending; this being apparently the only practicable means of settling the ruinous contests between capital and labour. Mr. Esson's address, we are sure, will be welcomed by all interested in the labour question, as a carefully weighed statement of the case, by one who has the advantage of being practically acquainted with the various elements of the problem.

Advertisement—fin de *Siècle*.

THE custom, common to only too many journals, of inserting conspicuous paragraphs, which at first sight appear to be *bonâ fide* items of news, and which upon examination turn out to be advertisements, has become a scandal and a disgrace to present journalism. Our contemporary, the *Electrician*, in a leaderette, calls attention to the case of the *St. James's Gazette*, a journal of some reputation, in whose columns appear, under the disguise of original matter, the advertisements of an "eminent" medical electrician. The paragraph referred to points out that this is a clear case of imposture, and more discreditable to the journal than to the advertiser. We are glad to see the *Electrician* join, although somewhat late in the day, in an attack upon this disreputable phase of journalism.

Render unto Cæsar, &c.

IT is sad to see to what extent the manipulators of paste and scissors are allowed to urge on their wild career unchecked. In the last issue of a weekly contemporary entitled the *Practical Engineer*, which, however, belies its name in this instance, we find that famous note culled from the "London Day by Day" columns of the *D.T.*, which has immortalised Earl Poulett and his yacht. If it had given our daily contemporary the credit of orginating the wonderful story of accumulator explosions nothing need have been said, but the paste and scissors gentleman has so far forgotten his mission in life that it appears as an editorial note in a technical journal.

Clear Off the Track.

IN a leading article devoted to the opening of the City and South London Railway, one of our contemporaries seems to have gone off at a tangent. Witness the following:—"We very much regret to hear that Messrs. Mather and Platt have contracted to run the trains at 3½d. per train mile for two years. This system has proved disastrous in both electrical and other mechanical tramway work, it has led to all sorts of complications and disputes, and has created antagonism where co-operation is essential. The local authorities themselves have not done so much harm to the development of electric traction as have tramway companies, who have tempted inexperienced inventors to make what they call demonstrations of their systems under this method of contracting at so many pence per car mile." We fail altogether to see any cause for the state of mental perturbation into which the editor of our contemporary has fallen and which has partially obscured his usual clearness of perception. Messrs. Mather and Platt can scarcely be called inexperienced inventors, and if they are satisfied that the power can be supplied at the price named, and the Railway Company accepts these terms, it is difficult to perceive why complications and disputes should crop up. With Dr. Edward Hopkinson's large experience of the Bessbrook and Newry line, Messrs. Mather and Platt are doubtless perfectly justified in the policy they have adopted, for our contemporary seems to forget that the previous electrical work in which "this system has proved disastrous" has always had the accumulator as the unknown quantity in the problem. Moreover, so far as we have been able to judge, the tramway companies have been the tempted, and not the Mephistophelian fiends who lure on misguided inventors to destruction; but, then, perhaps we look at the same things through different coloured glasses.

COMMUNICATIONS FROM AUSTRIA-HUNGARY.

[FROM A CORRESPONDENT.]

YOU have already announced the projected electric lighting of the Imperial Palace at Vienna, and the details have since been made known in semi-official circles. The installation, which owes its origin to the decision of the Emperor, will be completed by January 1st, 1891. It will not, however, for the present extend to the apartments of their Majesties, which will not be arranged for this purpose before next summer. There will be put up altogether 4,000 glow lamps, with an illuminating power of 4 to 5 normal candles. They will be introduced in the large reception rooms, consisting of the Hall of Knights, the Ceremonial Saloons, and the apartments for strangers placed behind them; the electric light will also extend to the great Ambassadors' Stairs, the St. Stephen rooms, and a part of the old Imperial Chancery. The large Ceremonial Hall, in which the Court balls are held, will have 1,500 glow lamps. All the old chandeliers, which are at present fitted up for wax candles, will remain, and will serve as mountings for the glow lights, the electric leads being conveyed through wooden pipes well varnished.

The electric lighting of the Royal Hungarian Palace at Buda, which, as I have already informed you, is likewise a decided matter, will not be carried out before next year, since it is feared that the adaptations might not be complete before the date when the Imperial and Royal family will take up their abode in the Buda Palace. Here, also, there will be used 4 to 5 candle glow lamps, about 1,500 in number, and, as in Vienna, they will be mounted like candles in the existing chandeliers.

At Fiume, the International Electric Company is about to erect extensive electric works from which 100 H.P. will be taken by means of alternating current motors for working the newly constructed elevator. The concession granted to the city has already received the sanction of the Municipal General Assembly. But here, also, the gas company is preparing on an equally frivolous pretext with those which I have described to you as having been raised at the Bohemian watering place Teplitz, to contest the right of the town to grant such a concession. I hope shortly to give you very interesting details on this question.

In the little South Hungarian town Karánsebes, the electric works erected by the firm Schmidt and Perlfasser at their own saw mills has come into action, and subscriptions for 500 lamps have already been taken up. This is the first electric works in Hungary for lighting a small provincial town, and has excited a lively interest in the neighbouring towns. It appears very probable that other Hungarian towns will shortly follow the example of Karánsebes.

The firm Müller and Einbeck, recently converted into a joint stock company, has also erected works at Baumgarten, near Vienna, for the manufacture of Tudor accumulators, and is about to open commercial and technical offices in Vienna.

The management of the Royal Hungarian State Railway has resolved to introduce the electric light in their trains, and in the first place in the express trains. At present a train of eight carriages is being experimentally arranged for the electric light, and the results obtained will be accepted as decisive for the introduction of this light on long-distance trains. The experiment will be carried out with accumulators supplied by the firm Müller and Einbeck.

The Electric Light in Leamington.—A controversy is in progress between the Corporation and Messrs. Chamberlain and Hookham respecting the quality of the light supplied to the borough. The authorities refuse to pay, and the Birmingham firm demand 5 per cent. on the unpaid account, at the same time stating it is their intention to apply for a provisional order.

A NOVEL COMBINATION ELECTRIC SWITCH.

By LIEUT. SAMUEL RODMAN, JUN., U.S.A.

IN presenting the following subject matter, I am led to believe that it may possess sufficient interest and value to warrant at least a passing glance from the readers of the *Electrical World*. Hardly a day passes but some new design in the way of a double or single pole switch is brought out. The one which I have devised, and will describe, is neither, but may better be called a continuous combination switch.

As it possesses certain characteristics different from other switches, I shall first go into a little preliminary detail, in order to make clear its functions and working. Referring to fig. 1, let A represent a strip of metal, and b, b', b'', b''' and b'''' metallic springs, so arranged that when A is moved up or down in the direction of the arrow, it will successively touch the metallic springs, b to b'''', until it reaches a position indicated by the dotted line enclosing A', when it will touch all five of the springs, b, b', b'', b''' and b''''. Move the metallic

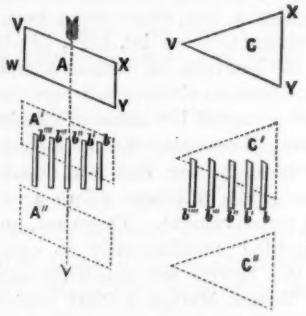


FIG 1. FIG. 2

strip now to the position indicated by the dotted lines enclosing A'', and it will be seen that it will slide past the metallic springs in the same order that it moved on to them. So, taking the movement in detail, we have the metallic strip first touching the spring, b; then b and b'; then b, b' and b''; then b, b', b'' and b'''; then b, b', b'', b''' and b''''; then b', b'', b''' and b''''; then b'', b''' and b''''; then b''' and b''''; then b'''', and finally sliding past all of them.

Referring to fig. 2, let C represent another strip of metal, and b, b', b'', b''' and b'''', as above, metallic springs. Move C in the direction of the arrow to positions indicated by the dotted lines enclosing C' and C'', and it will be seen that it will successively touch the metallic springs from b to b'''', and will slide past them in exactly the reverse order from b'''' to b. Taking this second example in detail, we have the metallic strip, C, first touching the spring, b; then b and b'; then b, b' and b''; then b, b', b'' and b'''; then b, b', b'', b''' and b''''; then b, b', b'' and b'''; then b, b' and b''; then b and b'; then b, and finally sliding past all of them.

By giving different shapes to the metallic piece which slides on and off the springs, other different combinations could be brought about; but the two general cases given will show that for the five springs taken there are nine different combinations of contact between the metallic piece and springs; or taking the more general case, and letting n represent the number of metallic springs, the different combinations of contact between the metallic piece will be represented by the general expression $2n-1$.

For a simple case to show how such an arrangement as I have described will apply as an electrical switch, I will refer to fig. 3, which represents a dynamo, one pole of which is connected to the metallic strip and the other to one terminal of each of a group of five lamps, the other terminal of the lamps being each connected to one of the metallic springs, b to b'''', as in fig. 1. Now,

suppose A to be moved in the direction of the arrow head, and, from contact with b, lamp C will burn ; then, from contact with b and b', lamps C and C' ; then, from contact with b, b' and b'', lamps C, C' and C'', and so on until A has moved past the springs and no lamps are burning. By this arrangement, then, we have 1, 2, 3, 4, 5, 4, 3, 2, and 1 lamps burning, or, in other words, we have varied the intensity of the light gradually and continuously. The example taken of the continuous gradation of light is presumably the simplest case. Many other applications may be made, substituting for the single lamps different coils of a shunt-wound dynamo or motor, or groups of lamps.

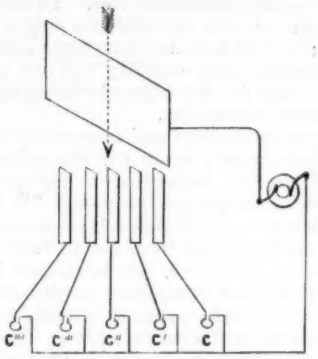


FIG. 3.

The number of metallic springs chosen in the figures is five, but it can readily be seen that by increasing the size of the metallic strip A, fig. 1, and C, fig. 2, almost any number of metallic springs can be accommodated, and also a greater number of circuits controlled continuously and successively.

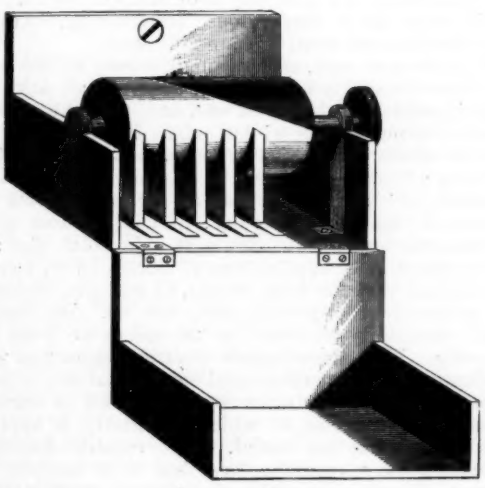


FIG. 4.

As a suggestion to those interested in the subject, I would propose the use of such a switch in connection with a shunt-wound motor on electric cars, in order that the current from the main dynamo may be thrown into the motor coils successively, increasing gradually the number of ampère turns, and possibly overcoming the difficulty and strain experienced in starting a heavily loaded car from a state of rest, and lessening the number of burnt-out armatures. By the use of such a mechanism no resistances are necessary, but the increments of current are supplied successively by a simple mechanical arrangement.

To resolve the mechanism above-described into an electrical switch, I simply make one mechanical change, and that is, to transform the motion of translation of the metallic piece A, fig. 1, and C, fig. 2, to a motion of rotation about an axis, and the following description of the switch will be sufficient explanation :—

A cylinder of insulating material having a metallic axis is first made. A thin flat metal strip shaped like A, fig. 1, or C, fig. 2, is then cut out and wrapped around the cylinder, the sides V, W and X, Y of A, and the point V and the side X, Y, of C, coinciding with the two opposite circular edges of the cylinder, thus forming a helical plate. The plate is secured to the cylinder by metallic screws which project through to a good contact with the axis. The latter revolves in a metal bed or bushing, and is held firmly by caps. The whole arrangement is set in a box of peculiar construction, as shown in fig. 4. The metallic springs are attached to the bottom of the box, and press firmly against the cylinder. On the under side of the box are binding posts, one to each metallic spring. The terminal of the dynamo is led in through the bottom of the box and screwed to the metallic strip shown on the right side of the box. This strip is maintained in metallic connection with the helical plate on the surface of the cylinder by means of the metallic bushing, axis, and screws connecting the helical plate with the metallic axis. The screw seen at the top of the box is intended to fasten the whole arrangement to the wall. It will be seen that the box can be readily closed and opened without removing it from the wall ; also that by taking off the caps over the axis of the cylinder the latter may be removed and the switch thereby rendered inoperative, so that the connection of the wires will not be attended with any danger. I think, at least, it can be claimed that the whole apparatus is very simple for one which combines so many different functions in so small a space.

THE CIVILIAN ELECTRICIAN IN MODERN WAR.*

By LIEUT. BRADLEY A. FISKE, U.S.N.

I BEG to propose for your consideration this evening a plan by which, in time of war, all the electrical resources of New York, both in supplies and in men, will become at once available for the defence of the country and the city.

It is well known to all here that electricity has come into use as one of the great factors in warfare, both on sea and shore, not as an adjunct merely, as for lighting ships and forts, but as a vital element in the handling of weapons in actual battle, and in the construction of new instruments which accomplish things heretofore impossible.

I desire to recall to your recollection a few of the most important uses to which electricity is now put in warfare, to indicate some of the probable paths of future development to show that it would be impossible for our regular navy and army to adequately handle the vast electrical work that would have to be instantly done in time of sudden war, and to suggest a plan for coming to their assistance.

The science of electrical engineering is now recognised as one of the most necessary of the practical sciences of the world. It stands out as distinct and defined as the science of medicine, or the science of astronomy, It enters into thousands of the departments of daily life, but into no other department is it used in so various and important ways as in warfare. This is so much the case that the prophecy is sometimes ventured that in the near future nations will fight by electricity. Though this, like all extreme statements, requires modification, yet the number of ways in which electricity has come to be applied within the last eight years is calculated to inspire the liveliest an-

* A paper read before the N.Y. Electrical Society, October 23rd 1890.

ticipations as to the developments of the next eight years. No vessel pretending to modern equipment goes to sea without a complete electric plant for furnishing light. This light is so much more suited to ship life than any other light that we now wonder that we ever went to sea without it. The electric motor is coming into use for ventilating ships, and it is beginning to be used for training guns and the hoisting to the deck of shot and shell. The best and the most accurate results at target practice are attained when the guns are fired by electricity. Range finders give the gunner constant knowledge of what he must know, *i.e.*, the distance of the enemy. The best means of night signalling, and the one adopted in nearly every navy in the world, is by means of incandescent lights. The electrical search light is almost as much a feature of the equipment of a modern war ship as are her guns and her torpedoes. In the actual use of the Whitehead and Howell torpedoes electricity plays an important part. The telephone is now coming into use for ship work, and will unquestionably supplant the speaking tube, which is acknowledged in all navies to be unsatisfactory. In fact, we find all through modern war ships an increasing use of electricity. The reason is clear. The modern war ship is the most intricate, tremendous and powerful machine existing. In no other equal space can be found so many, so various, and so important kinds of apparatus. Everything must be done which will put her absolutely within the grasp of the captain. She must respond at once to his command, and her whole strength and power must be his, as though she were a part of him. Ensconced in his armoured conning tower he must be the brain of the gigantic body. Electric wires must convey instant tidings to him from her innermost recesses, and electric wires flash back from him the inevitable command. In this way only can a modern ship, no matter how large, how strong, how heavily armoured, or how swift, completely fulfil her mission and be a perfect fighting machine.

What is true of ships is equally true of forts. The power of ships' guns has so increased that it has become necessary to protect shore batteries by iron and steel instead of masonry, as in the days not long gone by, and, in addition, to use disappearing carriages wherever it can be done. Disappearing carriages, as is well known, are so arranged, that the gun disappears below the parapet of the fort when the gun is fired, and remains out of sight and safe during the operation of loading, so that it is exposed only for a short time when it is raised to fire. Now, without the aid of electricity, a very considerable time would elapse, even after the gun was raised, before it could be fired, because the gun would have to be trained in the proper direction and be elevated to the proper degree for propelling its projectile over the distance between it and the enemy. To estimate this distance and make the proper adjustments would entail delay, and would be absolutely impossible if smoke obscured the target, as would be the case a great portion of the time. But electricity, acting through the medium of the position finder, gives the gunners continuous information of the distance and direction of the enemy, no matter how thick the smoke, so that they know exactly what to do before the gun is raised to fire.

Electricity, furthermore, gives the commanding officer complete control of all the different groups of guns and mortars in his fort. Noting the progress of the action from a station aloof from the smoke and noise, he can direct the concentration of as many batteries as he thinks best on one ship, or can disperse the fire as much as circumstances from time to time dictate.

For the handling of the monster apparatus used in forts, the guns, the carriages, the ammunition, electricity is rapidly coming to the front. Some power must be used, since the muscles of men are too weak. Hydraulic power has been used hitherto; but for many purposes electricity has the same advantages over hydraulics that have caused its unprecedented advance in the other departments of engineering throughout the world; while for repelling a night attack from ships, the search light has been found, by repeated trials in the naval manœuvres abroad, to be simply indispensable to the land defence.

For military service in the field there is not an army in the civilised world that has not its military telegraph service. One great cause of the suddenness and completeness of the German victory in 1870, was the rapid mobilisation of the Prussian army, and its appearance on the frontier ready for battle. Now the splendid efficiency of the telegraph service in the hands of the military authorities made this possible. Nothing is more important in warfare than despatch in moving the enormous bodies of men, of which modern armies are composed, with all their ammunition, equipments, and numberless accessories. To move a quarter of a million men to the frontier in a single day, means a good deal; and to manœuvre so large a body of men with such precision and rapidity that no one division shall have to wait for any other division, simply cannot be done without electricity.

But the most immediate and important use of electricity in the defence of a coast is in the submarine mine or ground torpedo. Defending a harbour with submarine mines is simply carrying out with more or less elaboration a system by which a large number of watertight tanks, each holding from 100 to 1,000 lbs. of gun cotton or other explosive, are anchored in carefully defined positions, and connected by armoured electric cables with protected operating rooms, in which are batteries, measuring instruments, &c. The more complete mines have usually floating above them automatic circuit-closers, in which two contact points are joined together by a passing ship, and thus afford a passage for the electric current to the fuse in the torpedo.

Now these mines are some of them exceedingly large and heavy, and the electrical apparatus, while simple to the mind of a trained electrician, yet must be made and adjusted with great care. The torpedoes as a system must be constructed, laid down, and connected to the operating rooms on shore by long and heavy armoured cables. The operation of practically planting and connecting the necessary submarine mines for New York would be a stupendous undertaking. Kindly bear this in mind until I recur to it again.

We have now seen, after a rough survey of the subject, that electricity has already acquired an acknowledged position in the art of war, and that the uses to which it is put are not trivial ones. Electricity is not used in warfare as a convenience, nor is it a fad of theorists; it fires the guns, it discloses the stealthy approach of the torpedo boat at night, it directs the proper elevation of the guns; in fact, it does good, honest, practical work. But note this point also: in every one of these applications of electricity we have to pay, in one way, for what we get, by studying the ways in which electricity will work for us. We cannot expect electricity to work for us unless we treat her properly. We cannot handle electrical apparatus with carelessness and ignorance, and expect that it will work when we need it. In other words, we find in warfare, as in everything else to which electricity is applied, that electricians are useful. This remark doubtless seems absurdly commonplace, but it is intended to suggest that, in war time, electricians, even civilian electricians, may suddenly become very useful to the Government. A captain of a fine ship might lose an action from simply a lack of knowledge as to some electrical appliance on his part, or on the part of some subordinate; some small accident might break a circuit just at a critical juncture, which might prevent the communication of an order, the receiving of information, or the firing of a torpedo at a crisis; and yet the cause might be such, that a man with even a very slight knowledge could remedy the difficulty in a second by the mere pressure of his finger; but that pressure not being given, the action might be lost, and from that cause alone.

Let us now glance at some of the other uses of electricity to which it would probably be but in case of an attack upon New York. There can be no reasonable doubt that Lay torpedoes, Patrick torpedoes, Sims-

Edison torpedoes, and Halpine-Savage torpedoes would come to the front at once. The enemy's fleet being daily expected off Sandy Hook, we should see the advocates of these systems, under authority of the general government, preparing stations at Coney Island, Sandy Hook, and elsewhere, for the launching of their dreadful missiles against his ironclads. The question of ballooning, both for observation and for the dropping of explosives on his decks, would be taken up at once, and the electrical world would be agitated anew over the question of balloon propulsion by electricity. Electric launches, ranged to carry torpedoes, would be fitted out to noislessly steal out at night on their errands of destruction. Electric picket boats of smaller size, perhaps, would scout the waters in pursuit of information, or to convey despatches; electric submarine boats would spring into being by the dozen, and, filled with adventurous spirits, would seek the enemy, secure from detection below the surface of the sea, and carrying enough explosives to utterly destroy the proudest war ship of the world.

It will now be apparent that in the case of a sudden war (and most wars are sudden), there will be an immense amount of work to be done in the electrical line alone. Could our regular army and navy do all this work in the time allowed? It is probably known to all here that our regular army and navy are simply a nucleus around which fighting forces could be formed. They are so small as regards both officers and men, that they can barely carry on the work in time of peace, and would be wholly inadequate in time of war. We should not have enough battle ships, monitors, cruisers, or torpedo boats; we should not have enough forts; we should not have enough sailors; we should not have enough infantry; we should not have enough artillery; we should not have enough electricians. Take the single matter of laying out and connecting up the submarine mines in New York harbour. This is an area covering many square miles, in parts of which the mines would be placed at frequent intervals; every mine being accurately secured in its designated place and connected by cable to the operating room, perhaps miles away. The mere labour of constructing, fitting and filling one mine, and afterwards taking it out into the harbour and lowering it into place, with all its connections, is no small task; and what can be said of the task of doing this with hundreds of submarine mines? Then the work of properly arranging the various cable connections, testing apparatus, firing apparatus, &c., necessary for the efficient action of the mines would follow. The Board on Ordnance and Fortifications have designed all the torpedo defences, but they will not be in practical operation, probably, for many years, and a war may come meanwhile. But it is certain that on the outbreak of any war an immense amount of this work would have to be immediately done, because we will never keep the submarine defences of New York harbour on a war footing in time of peace.

The Navy Department would be even more hurried. We should certainly be called upon to commission a great many war ships, and to equip as commerce destroyers a great many merchant steamships; we should have to do all the things that we did on the outbreak of our last war, and in addition, we should be confronted with the necessity of fitting all kinds of fine apparatus, the necessity of fitting electrical appliances of all descriptions, besides securing gun-circles in place with mathematical precision, and of accomplishing all the manifold fine work that is required with the ordnance, navigation and engineering equipment of a war ship of the present day. And as to fitting on merchant ships, who is going to fit them out? This operation requires technical knowledge. Who has it? How many of the merchant steamship captains would be able to install and manage a battery of even Hotchkiss or Driggs-Schroeder guns, or could remedy an accident to either gun or ammunition?

It being apparent that the regular army and navy in event of a sudden war would be unable to handle all the electrical work that would certainly be thrown upon them, I will propose the formation of a corps of naval and military electricians to assist the regular army and navy in its work. Such a corps might exist in every principal seaport town on the coast; the principal one, of course, being the corps with headquarters in New York. Electricity being now a recognised factor in both naval and military war, and requiring expert electricians for its full development, there would seem to be just as much reason for an electrical corps in the National Guard of the State of New York as for infantry, artillery or cavalry. While the members of this corps would be men of technical knowledge, and while its sphere of usefulness in war would be because of that technical knowledge, it is obvious that the organisation should be a military one, and that with some modifications it should be governed by the same principles as govern all military bodies. Being a military body under the Governor of the State, it could at once become available at the outbreak of war.

It would seem that this corps, like all other corps, should be composed of men of various ranks, subject to various duties. Many kinds of work would have to be done in war, and many kinds of men would be required to do them. On the outbreak of war, certain members would naturally elect duty in the navy; others in the army. The most obvious and immediate employment would doubtless be in the torpedo defence of the harbour, under the direction of the general commanding. And who can doubt the gratification which that general would feel, when suddenly ordered to defend New York Harbour, on finding added to his list of subordinates a hundred or more capable electrical engineers, young, enterprising, accustomed to difficult electrical work, familiar not only with electricity in its technical features, but also acquainted with the electrical people of New York, with its factories, its places of business, and its methods of business. These men would become available in a day, and could be at once set to work in carrying out the details of the vast and complicated system. Their work need not be confined to that purely electrical in character, because every electrical engineer is, by training and of necessity, a mechanician, and every sort of apparatus would be readily understood by him, and a very slight training will make him master of it. Those members volunteering for naval work would be equally useful. The ordnance officer at the Navy Yard would suddenly find himself overwhelmed with a mass of work which he would be utterly unable to carry out without the assistance of some such sort as this. And for the reason that electrical engineers are of necessity mechanicians, a great deal of technical work could be entrusted to them, such as the arrangement and fitting of gun carriages, the storage of ammunition, the assembling of guns, &c. Their more immediate and obvious field, however, would be the installation and fitting of electric lights, motors, telegraphs, telephones, and other electrical appliances on board the vessels of war suddenly called into requisition. In the matter of fitting out merchant steamships their usefulness would be at once apparent. The number of regular officers would be found utterly out of proportion to the number of ships; the whole navy would have to undergo an expansion. Only a very few regular officers could be assigned to each vessel; so that the majority of officers would have to be volunteer officers, as was the case in our Civil War. During the first part of the war the command of the different vessels would naturally be intrusted to regular officers leaving the other positions to be filled by volunteers. Now, as the commander of a ship is head of all the departments of a ship, he cannot give much personal attention to one special department. Therefore, the general arrangement and fitting out of all vessels, both regular war ships and merchant steamships, would have to be largely entrusted to volunteers in all that relates to the electric and ordnance equipments. Now, as the work of fitting out ships with electric and ordnance equipments calls for technical knowledge and experience of a high character, it is obvious that a corps of well-trained technical men, such as here suggested, would be more than useful, they would be necessary.

C

A further field for employment of such a corps in time of war is suggested by the fact that the genius of our people tends towards constant invention and improvement of all sorts of machinery and apparatus, and our history has shown that every war has brought into being many inventions in weapons of defence and offence. Can it be doubted, then, that any future war would produce more such inventions? And in view of the great progress of electrical science since the last war, and in further view of the large number of electricians in New York, can it be doubted that many of these inventions would be electrical in character? Under the stimulus of a national peril, and with the resources of New York at command, it is certain that important and noved warlike applications of electricity would at once spring into being. And while our regular forces of both army and navy were employed on their specific duties, what more natural than that some new Ericsson should arise, and some new "Monitor," or other craft, startle the nations ef the world? Therefore, besides the obvious uses to which such a corps as this might be placed, there are other uses, no less important, of inventing, constructing and using weapons of defence, the nature of which we cannot as yet even faintly conceive. And as few heroes of our late war go down to history with more glory than has Ericsson, so, perhaps, our next war may produce some electrician now unknown, whose fame will outlive the ages.

It would seem as if such a corps as this could be formed under existing laws, and that there would be no difficulty in enlisting members. The attractions of the Naval Reserve and of the National Guard seem sufficient to induce a large membership in the different regiments, and there is no reason why membership in an electric regiment should not be equally desirable and confer equal distinction. The qualifications for entrance as regards education and intelligence, would be greater than those for any other regiment, corps or battalion. Its military and naval usefulness would be acknowledged, and its position in all respects would be one of dignity. The larger the membership, the better, provided, of course, that due care be observed in excluding undesirable persons. The whole electrical influence of New York and of the country would be at its back, with all its millions of dollars and its men of world-wide fame; and there is no reason why it should not acquire a national influence. The course of instruction could be readily carried out, embracing the naval and military applications of the purely technical science, with which the members are already familiar, instruction being given by regular navy and army officers detailed for the purpose. This instruction would naturally embrace the construction and care of apparatus. It being presupposed that there are different ranks in this corps, the system of instruction will naturally differ with the different ranks. With the higher ranks, it would naturally embrace the theory and practice of gunnery, navigation, including compasses, and seamanship. Steam engineering would probably not need to be taught, it being assumed that the members require very little instruction in that branch. For the lower ranks the scheme of instruction need not include much more than the handling and care of the different apparatus. On the outbreak of war the members volunteering for the different services could be subjected to certain examinations, and their rank determined by the proficiency exhibited. As to the details of organisation, uniform, &c., these need not be entered into here, as they can obviously be settled at any future time. My only purpose now is to propose to you a plan for meeting an emergency, which may some day arise. I would hazard the suggestion that the corps or battalion should at first include about 250 members, and that it should be officered, uniformed and drilled in much the same ways as the other corps of the National Guard. I would even advocate a certain amount of infantry drill as a means of instilling the military idea. Occasional runs in the torpedo boat *Cushing*, and frequent short trips out to sea for target practice in modern war ships, would be essential. There would be considerable work, but there would be many compensating social and other advantages. I have ventured with much diffidence to put forward this idea, but earnestly hope that you will think it worthy of earnest consideration. My only excuse for broaching it is that it has been in my mind for many years, that it has been commended by every man to whom I have spoken about it, and that I have been urged to bring it to the attention of the electricians of New York.

THE PARIS TELEPHONES.

THE new service of telephoned messages began working on the 3rd inst. On the morning of that day, the Administration of Posts and Telegraphs posted up the following notice:—"On and from the 3rd November, 1890, the public is allowed to send telephoned messages to any address included in one of the streets situated between the Seine and the grand boulevards. The price is fixed at 50 centimes per five minutes' occupation of the cabin. The length of occupation is limited to a maximum of ten minutes, when others are awaiting their turn of communication. For the transmission of messages, communication can only be demanded directly by the sender." Thus a telegram can now be telephoned, provided one is within the radius served by the ten telegraphic offices situated between the Place de la Concorde, the Seine, the grand boulevards, the Place de la Bastille, and the Boulevard Henri IV. He can telephone from any point, but only messages for persons living within the above-mentioned radius will be admitted. If this attempt succeeds, it will be successively extended to the rest of Paris, and also to the suburbs.

The following are a few details of the new central telephone office which is being built on land between the Rues Gutenberg, Jean Jacques Rousseau, and du Louvre, with its principal frontage to the Rue Gutenberg. The ground floor will serve as a standing place for the vehicles of the postal authorities. On each of the four floors will be found a large hall, 60 metres long by 10 wide. In these halls will be placed the apparatus, which will enter the building in the cellar through the sewers, and will be distributed between the four floors, which will share the telephonic transmissions and receptions of the four zones of Paris.

Our Parisian contemporaries keep up a running fire of comment, sarcastic and otherwise, on the telephone working in Paris. One of them, for instance, relieves itself as follows:—The service of pneumatic tubes is decidedly as defective as that of the telephones. It is thus that a *carte-télégramme* registered at 11.35 on Friday morning at the Bourse office, was delivered at five minutes past four in the afternoon at Montrouge. This fact is noticeable at a time when the trial of telephoned messages is going to call upon the deplorable services of the telephones and the pneumatic tubes to lend assistance.

There has also appeared in the *Journal Officiel* a decree which creates, for the night, a conversation tariff at reduced price in the interurban correspondence service. This tariff is fixed per unit of telephonic conversation, and per 100 kilomètres or fraction of 100 kilomètres of distance between the points joined by the telephone line, at 30 centimes for ordinary conversations, and at 20 centimes for conversations by subscriptions. The subscription includes the daily use and at a fixed hour for a five minutes' conversation for a circuit specially designed, the minimum duration being one month. The subscribers obtain communication at the precise moment provided there is not a conversation on between two other persons. The time not used at one conversation cannot be carried over to another, save and except the non-use be due to an interruption of the service. After a first interruption of the service of 24 hours, there is to be returned to the subscriber, for each further period of 24 hours, a thirtieth

of the amount of the subscription. The circuits over which this reduced tariff is to be applied and the hours during which the conversations may take place under this decree will be determined by ministerial warrant.

STREET RAILWAY MEN AT BUFFALO.

ELECTRICAL engineers have again been enthusiastic over the cordial reception they received from the American Street Railway Association, which held its ninth annual meeting at Buffalo, N.Y., during the week ending October 17th. Mr. Thomas Lowry presided over an assembly of nearly 500 gentlemen interested in every branch of street railway business, and he opened the proceedings with a pithy address, setting forth the general progress of tramway building and tramway working in the United States. Mr. Lowry pointed out that in the smaller cities electricity is generally being adopted, and there are already about 1,600 miles of electric railways in operation; but municipal corporations in the large cities, with the exception of Boston, are slow to grant new privileges. He hoped, however, that when the people understand clearly the great benefits of rapid transit, by electricity or other improved motive power over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most approved methods. From these remarks of the President one would naturally infer that in large cities electric traction *per se* has been objected to, but we know it as a fact that such is not the case, and that systems devoid of overhead conductors have actually been encouraged by the authorities who are merely anxious to get rid of overhead wires in general.

The first communication was a "Report on Electric Motive Power Technically Considered," by Dr. W. L. Allen, which fully discusses the various electrical and engineering details of an electrical railway. This is a thoroughly practical paper, showing up the defects which have been made manifest during prolonged operation, and it suggests sensible remedies in several instances. The author gives a list of breakdowns which occurred at various periods on one of the Thomson-Houston roads, and he shows that most of these were of a mechanical nature. During 14 consecutive days in July last, out of 150 to 200 cars in operation, 26 were disabled through electrical defects, and 158 breakdowns of a mechanical nature occurred. From this it appears that about 1 per cent. of the cars operated were disabled each day from electrical causes, and about 6 per cent. from mechanical causes. As the report does not state the nature or degree of electrical disablements, it is not fair to assume that they were all due to crippled armatures. All that can be deduced is, that a car may run 100 days without electrical repairs, and only 17 days without mechanical repairs; the cost of this is not stated. In the case of four Sprague cars running on another road, the repairs for six months have cost $1,191. On these four cars were worn out, 3 bronze pinions, 11 steel pinions, 6 spur wheels, 6 axle brasses, 8 shaft bearings, 12 armature bearings, 180 carbon brushes, 6 trolley wheels, and burnt out 3 field magnets and 6 armatures.

"Public and State Treatment of Corporations," formed the theme of a paper by Mr. G. H. Scribner; this, though interesting, and in some points applicable to our own municipal institution, scarcely comes within the province of an electrical journal. Mr. D. H. Bates read a paper on "The Edco Storage Battery Car," enumerating the conveniences of self-contained cars, and the disadvantages of systems having overhead and underground conductors. There is nothing novel in this paper, and the figures on the cost of traction by means of the Edco system are, of course, hypothetical. The discussion, however, brought forth the interesting fact that various storage battery cars are now being introduced on several new lines, and additional ones put on existing lines.

Mr. Carruthers Wain, of London, was one of the guests at this Convention, and when called upon by the President, gave a description of the accumulator cars which are being tried on the Birmingham central tramways. He stated that during the time the electric cars were in process of construction, the receipts on the *horse* cars amounted to $600 a week. Immediately the electric cars were put on, the takings jumped to $1,250 a week. This was not due to any additional service, because it is precisely the same; not to any increase in population, because it has not grown so rapidly, but simply to the fact that they had been able to put on, in place of the wearisome horse car, a comfortable car moving by electric power. Mr. Carruthers Wain concluded in saying that the question of profit on the workings of the storage battery is not a matter of speculation, but is a matter of dead certainty.

THE PRESENT COMMERCIAL POSITION OF ELECTRIC LIGHT COMPANIES.

THE present position of the various English electric light companies, from a commercial point of view, is not very satisfactory, and the thought has not infrequently arisen in the minds of some shareholders as to whether they might not have invested their money to greater advantage. It was, however, not to be expected that during the first few years of working the dividend paying stage would be reached, although, in two instances, the statements made in the prospectuses were rather too confident of quick returns—a policy which cannot be too strongly deprecated. Nevertheless, the different metropolitan companies are now settling down steadily to work, and in the course of another year or two, it is possible that the anticipations of the shareholders will be realised, at least, to a certain extent.

It may, however, perhaps be interesting to review the present commercial position of the companies, and to consider their future prospects. Taking the London companies in the order of their share capital, the following table shows the names of the companies, the nominal share capital, the amount paid up, and the approximate number of lamps supplied, the figures being obtained from the latest available official returns:—

Name of company.	Nominal capital.	Amount paid up.	Approximate number of lamps supplied with current.
London Electric Supply Corporation	£1,250,000	£654,690	40,000
Metropolitan Electric Supply Company	500,000	201,583	40,000
House-to-House Electric Light Supply Company	350,000	36,610	10,000
Westminster Electric Supply Corporation	300,000	18,000	6,000
Kensington and Knightsbridge Electric Light Company ...	250,000	49,780	20,000
Chelsea Electricity Supply Company	100,500	50,000	20,000
Notting Hill Electric Lighting Company	100,000	14,734	...
St. James's and Pall Mall Electric Light Company ...	100,000	26,000	21,000

It has not yet been ascertained how much of the gross revenue is absorbed by working expenses, depreciation, &c., but these items are estimated by two companies to amount to about 50 per cent. of the total receipts. This percentage may possibly be considered to be high, being in fact slightly less than the working expenses on an ordinary railway, where they are naturally considerable. The annual income derived from an 8-C.P. lamp installed is variously estimated at from 10s. to 14s., or an average of 12s.; and from an 8-C.P. to a 16-C.P. lamp, £1 per lamp. We will, however, take an

average of these two, namely, 16s. per lamp installed. It will, therefore, not be difficult to estimate the average number of lamps which must be in use throughout the year to enable the companies to pay a dividend of 5 per cent. on the total paid capital, providing, of course, that the working expenses, &c., do not exceed 50 per cent. of the gross receipts. For instance, the London Corporation would have to supply about 80,000 lamps, although, considering the excessive cost of maintaining such a huge station, this number would doubtless have to be increased by probably 50,000 lamps.

The Metropolitan Company, with one-third less of paid-up capital than the London Corporation, would only have to furnish 30,000 lamps, while the House to House Company, with its present number of lamps in use, should afford a fair return at the end of the next financial year. The company, which is expected to yield probably the best return on the invested capital is, however, the St. James and Pall Mall Company which, in a remarkably short period, has obtained customers to the extent of about 21,000 lamps.

It might be supposed from the figures given in the table regarding the paid up capital and the present approximate number of lamps alight, that some of the companies are already in a position to declare a dividend. This assumption is, however, incorrect. The number of lamps stated are those which are at present in use, but these must be the *average for the year* to yield any return; moreover, since the figures concerning the paid up capital were compiled, more calls have been made on the shareholders. Thus the approximate number of lights which would have to be supplied as previously stated would have to be increased by, say, 20 per cent. It may, however, be concluded that the commercial position of the metropolitan electric light companies is gradually improving, that in the course of a year or two the dividend-paying stage will be attained, and that the shareholders may rest assured that their investments are assuming a form of stability.

A. W.

THE PRENTICE MAGNETIC CUT-OUT.

THE accompanying illustrations represent a new magnetic cut-out, which is being placed on the market by Mr. Napier Prentice, of Stowmarket, Suffolk. The cut-out comprises an electro magnet wound with wire, included in or taken as a shunt from the circuit to be controlled, the external wires being secured by the binding screws shown. These screws are arranged on conducting pieces, one being electrically connected with the conducting piece carrying the mercury cup on the right, and the other being similarly connected through the coil of the magnet with the conducting piece carrying the second mercury cup. Into these cups dip the ends of the horizontal bridge piece, which is provided with arms carrying the armature. These arms are connected by a cross piece extending behind the vertical lever, which has a counterbalance weight at its upper end, and a tail piece constituting a kicker. The screw shown in front of the armature permits of the position of the latter relatively to the end of the magnet core being adjusted. The parts are mounted upon a base of enamelled slate. When the normal current is passing, the armature, bridge, arms, and lever remain as shown in fig. 1; but on the current increasing abnormally, the electro-magnet attracts the armature and the cross piece moves the vertical lever so that its weighted head causes it to fall over in such a manner that its tail end kicks the bridge and knocks it over into the position shown in fig. 2, thus removing the contacts out of the mercury cups, and breaking the circuit.

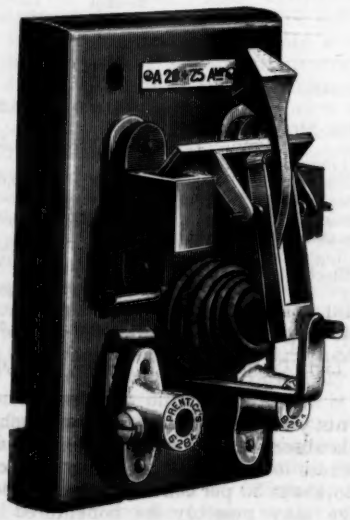


FIG. 1.

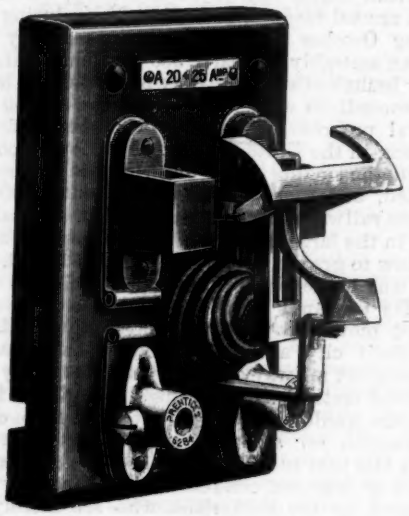


FIG. 2.

GOOLDEN AND CO.'S STEAM DYNAMO.

WE illustrate in our present number a steam dynamo constructed by Messrs. W. T. Goolden & Co., which differs in some essential features from the common arrangements of dynamos, coupled as in this case to Willans engines.

The steam dynamo illustrated is one of a series constructed for the St. John's Wharf Central Station of the Westminster Electric Supply Corporation. It will be noted that the overtype pattern dynamo has been adopted, this being, in the opinion of the makers, a superior arrangement in all cases of dynamos not exceeding 50 kilowatts output, the armature being readily removable without taking away any part of the field magnets, and the brushes, both upper and lower, being readily accessible.

The dynamo itself has the field magnets of wrought iron, bored out to receive the armature; these are bolted to the bedplate, which forms the back yoke of the magnets. The bore of the fields is so arranged as to allow a greater clearance at the lower part than at the upper, thus doing away with a slight downward pull due to unequal distribution of magnetism in the upper and lower half of the armature.

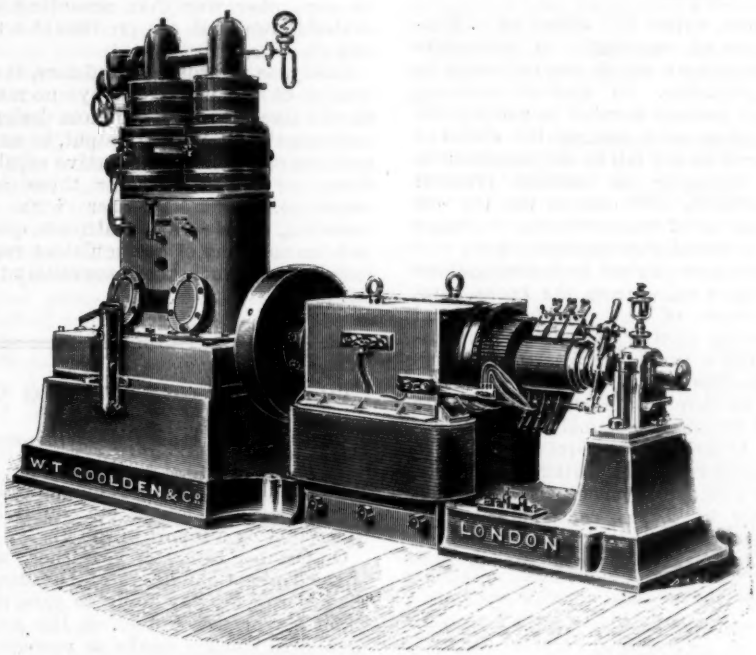
The outside end bearing of the dynamo is mounted in a spherical seating, to allow it to adjust itself in the event of uneven wearing of the different bearings, and prevent any strain being thrown on the shaft.

The armature is a special pattern of bar armature, which has been adopted by Messrs. W. T. Goolden and Co., the bars themselves being laminated, and connected at the ends by a "solid built" armature end composed of V-shaped radial strips, built and insulated with mica, after the manner of a commutator, in combination with spiral strips, also separated and insulated with mica.

The armature end built in this manner, which presents the appearance of a solid disc, is mechanically very strong, and prevents the ingress of dirt or wet, which often affects the insulation at the ends.

The field magnets are internally, as well as externally, ventilated.

The brushes are of Messrs. Goolden's patent type, having screw feeds, enabling them to be fed forward whilst running, without unslacking any nut or screw.



COMMERCIAL EFFICIENCIES OF DYNAMO AND STEAM DYNAMO.

I.H.P. reduced to watts.									Output in watts.			Efficiency.	
Proportion of full load.	Loss in shaft.	Loss in core.	Loss in bars, eddy currents.	Loss in armature resistance.	Loss in field magnet coils.	Total loss in dynamo.	Loss in engine.	Total loss in dynamo and engine.	Volts.	Ampères.	Watts.	Commercial efficiency of dynamo.	Commercial efficiency of combined engine and dynamo.
1	290	1,220	254	1,820	660	4,244	6,300	105,44	120	375	45,000	91·2 p.c.	81 p.c.
½	290	1,220	254	520	660	2,944	6,300	92,44	120	200	24,000	89·1 p.c.	72·2 p.c.
¼	290	1,220	254	130	660	2,554	6,300	8,854	120	100	12,000	82·5 p.c.	57·5 p.c.

The following tests which have been made of these machines are interesting, as showing the proportion which exists between the various losses occurring in a steam dynamo of this class, and which is to be noted, that although the efficiences given are exceedingly good results, the engines and dynamos were perfectly new at the time of the tests, which were made for the makers own information, and not originally with a view to publication.

The electrical data are as follows :—

Volts, 120 ; ampères, 375 ; watts, 45,000 ; speed, 440 ; armature resistance, ·013 ohms ; resistance of field magnet coils, 21·4 ohms.

Indicator tests of Goolden-Willans combination :—

1. The engine was run, with the armature disconnected, and found to absorb 8·43 I.H.P. when running light at 430 revolutions.

2. The armature shaft and core were put in place, no windings being on, and running with the fields unexcited 9·92 I.H.P. was recorded, equivalent to 1·49 I.H.P. for the shaft.

(It is to be noted that this is excessive, as the bearing at the time was running hot.)

3. The core being in, the fields were excited, and 11·56 I.H.P. recorded, the loss in the core being thus 1·64 I.H.P.*

4. The armature was wound, and another test made, first unexcited then excited, and deducting the value for the losses in engine, shaft and the core previously ascertained, the loss in Foucault currents in the bars was found to be ·34 I.H.P.

The experience and experiments of Messrs. Willans show that the frictional loss in the engine is nearly independent of the load. Hence, from the above figures, the efficiency of the steam dynamo can be given for any load, and the commercial efficiency of the dynamo calculated for any output.

The table below shows the calculations tabulated, it being noted that the loss in the shaft friction has been taken at ·39 I.H.P. (this value was found to represent an average in later tests, the above value being exceptional, owing to the circumstances mentioned, but the individual test being for a difference, this was unimportant).

These calculations accord well with direct indicator

* The loss in the core is probably considerably augmented by the fact that this dynamo was originally intended for 105 volts, but the field excitation was raised to give 125 volts at the original speed, the induction being thus increased, the leakage through the shaft and spider has been increased, thus causing eddy currents and loss.

tests. The dynamo giving 43,400 watts, the efficiency as indicated was 80·4 per cent., and, when giving 26,500 watts, the efficiency was 72 per cent.

Independent tests of these dynamos and engines at the stations, supplying current to the Houses of Parliament, have been since made by Prof. A. Kennedy, consulting engineer to the Westminster Electric Corporation, giving even better results than the above. The commercial efficiency in some reached as high as 85 per cent. and 86 per cent.; but as further tests are being carried out on the same machines, the results are not yet complete.

THE NOMINAL LUMINOUS POWER OF CONTINUOUS CURRENT ARC LAMPS.

WE have long protested, writes the editor of *L'Electricien*, against the use of unsuitable or inaccurate terms, and vague designations which are only kept in use by custom and prejudice. By dint of repeating our assertions we may perhaps succeed in getting the matter taken up by others who are not the slaves of custom; we shall therefore not fail to call attention to abuses of this kind whenever an occasion presents itself. We will, therefore, now discuss the (in our opinion) deplorable custom of characterising arc lamps by their more or less nominal photometric power.

In order to show how meaningless such designations are, we have drawn up a table from the books, catalogues and prospectuses of the chief industrial celebrities of both worlds, placing opposite each intensity of current feeding a given arc lamp, its corresponding nominal photometric power. In order to facilitate comparison we have reduced all the intensities expressed in carcel burners to decimal candles, considering the carcel burner to be equivalent to 10 decimal candles, although really, according to M. Violle, 20 decimal candles = 2·08 carcel burners; there is, consequently, a difference of 4 per cent. between the decimal candle and the tenth of a carcel burner, but our estimate will be sufficiently accurate for our purpose.

Table of Nominal Intensities of Arc Lamps according to the constructors.

Intensity of current	Sautter-Lemonnier	H. Fontaine.	Cance (under a globe).	Schuckert.	Crompton.	Latimer-Clark.	Ball.	John Davis.	Antwerp experiments (1885).	M. Tschebendorffer's Formula.
Ampères.	B.D.	B.D.	B.D.	N.K.	C.	C.	C.	C.	B.D.	N.K.
4	200	...	250	300	...	...	800	...	526	300
5	350	500	300	...	500	400	...	400	...	...
6	500	...	350	600	...	...	1,200	...	487	625
7	...	...	400	...	...	...	...	...	...	...
8	...	1,000	450	1,000	1,000	...	1,600	...	600	1,000
9	...	...	Breguet	...	...	...	...	...	...	...
10	...	...	700	1,400	1,400	1,500	2,000	1,000	700	1,425
11	...	...	...	...	...	...	...	...	...	...
12		...	...	2,000	...	...	...	1,500	...	1,900
13	1,500	...	...	...	...	...	...	...	1,190	...
14	...	...	...	...	...	...	...	...	...	2,425
15	...	2,000	...	...	...	3,000	...	2,000	1,380	...
16	...	...	...	3,000	3,000	...	...	...	1,660	3,000
18	...	...	...	...	...	...	...	...	...	3,625
20	...	...	1,500	4,000	4,000	...	...	3,000	1,980	4,300
22	...	...	...	...	...	...	...	...	...	...
24	5,000	...	...	...	...		...	...	...	5,800
25	...	3,500	...	...	...	...	...	...	...	...
30	...	...	...	...	...	...	...	...	...	8,425
40	...	..	...	...	...	...	...	...	...	13,800
50	20,000	...	...	...	...	..	...	...	...	20,425
60	...	10,000	...	...	...	...	...	...	...	...

(B.D.—(decimal candle). N.K.—German normal candle. C.—English candle.)

The figures in this table show that a constructor, describing his machine as producing so many arc lamps of so many candles each, gives it a designation which may perhaps facilitate its sale, but which is practically meaningless, since, with a given current, the quality of the carbons, the distance between them, their diameter, &c., may cause the luminous intensity to vary considerably, its value being in some cases even more than doubled. And we must not lose sight of the fact that in arc lamps mounted in derivation, the available potential at the terminals of the lamp being from 43 to 45 volts, some installations work at 80 effective volts, others at 75, 70 or 65, the difference being absorbed at an utter loss in a rheostat.

The same objections may be raised to the mode of designating dynamos and transformers by the number of incandescence lamps that they can feed. Some constructors mean lamps of 30 watts, others lamps of 40, 50, 56 or 60 watts.

A dynamo or transformer should never be designated in any other way than according to the number of available watts it can produce at a maximum normal charge.

Lastly, as regards accumulators, the statement of the weight of the plates conveys no meaning to us. We should like to see accumulators designated according to their maximum normal output, in ampères or in watts, and according to their effective capabilities in ampère-hours or watt-hours, for these are the principal essentials, which together with their price and duration, enable us to calculate quickly the number and the coupling of accumulators required for a given installation, much more accurately than the weight of the plates.

THE ELECTRIC LIGHTING OF DRESDEN.

[FROM A CORRESPONDENT.]

WHAT is thought in municipal circles in Dresden on the present position of electric lighting is curiously illustrated by a report in the *Teplitz Zeitung*.

On October 16th, this year, there was held a session of the Town Councillors of Dresden, the first item in the order of the day being to receive the report of the Chief Mayor, Dr. Stübel, on the preliminaries for the municipal electric works as proposed for Dresden. It is known that after various explanations and negotiations with Siemens and Halske, of Berlin, and the German Edison Company of the same city, who had both submitted calculated projects, it was resolved by the Dresden Town Council, on May 1st, 1887, that electric works should be erected at the cost of the city, to which resolution the municipal delegates gave in their adhesion on May 26th of the same year.

A mixed committee for this affair was then formed, and projects were submitted by Siemens and Halske, Kummer and Co., and Schuckert and Co. The German Edison Company had withdrawn its proposals. In the report of the Mayor-in-Chief, Dr. Stübel laid before the above municipal session the erection of a municipal electric works for a maximum connection of 25,000 glow lamps, and an outlay of 2½ million marks was recommended. The number of the gas flames installed in Dresden consists of 6,300 street lamps and 175,000 private lights. Consequently the proportion between electric light and gas expected by the Dresden authorities was 1 : 7.

At the meeting of representatives on October 16th, 1890, Dr. Blochwitz acted as reporter of the committee, which proposed that, "The committee decline the proposals of the Town Council, and hesitate at present to undertake the erection of municipal electric work, and prefer to await the results of the electric exhibition, to be held at Frankfort-on-the-Maine in 1891, and at the same time express the wish that in future, as in all extensive municipal undertakings, a competition should be invited, and that after the presentation of the projects a committee, consisting of at least three experts, should be formed for their examination."

In support of this motion, the reporter submitted that haste should be avoided; the affair was too serious, and millions of money might be sunk too rapidly. The charge was brought against Dresden that it came halting in the rear of all improvements; this was not here the case; there were not, so far, many electric stations, and a variety of experience will be obtained. The application of the accumulators recommended by Siemens is for the present merely an experiment. There are many more important things which should be done first—*e.g.*, the market halls, the exhibition hall, &c. He strongly urged that the proposal of the committee should be accepted. The town councillor Hartsig followed on the same side. He had, he said, informed himself practically on the electric lighting in Berlin. The frequent repairs which were there required in the cable from the Central, and other experiences, induced him to agree fully with the recommendation of the committee. He was of opinion that more experts should have been consulted. Above all, he regarded it as necessary to mention something which had not yet been openly brought forward, *i.e.*, the general public was of opinion that the electric lighting of the streets was involved in the erection of electric central works. This is an error, as nothing of the sort is, for the present, in contemplation. The public has therefore at present no immediate interest in the question. The loss and the interest on the say, three million marks required for the new works, must ultimately fall upon the community of the tax-payers. The entire installation was merely for people of distinction; for the little man (*anglice* for the poor man) there was here nothing. Lighting with the aid of accumulators was so young a child, that it might well be allowed to grow for a couple of years. There was no pressure; the electric lighting of business houses, offices, saloons, &c., is not absolutely necessary, like street cleansing, water supply, &c.

In Berlin he had heard nothing but lamentations from men of business compelled, by competition, to adopt the electric light, and troubled by the high price and the frequent repairs. He found the restaurants and cafés lighted electrically generally very dim, so that it was often scarcely possible to read the papers.

After some concluding remarks from Blochwitz, the reporter who said that the introduction of the electric light would not diminish the income of the gas company, the opinion of the committee was accepted by 47 votes against 17.

THE BULL RING OF THE RUE PERGOLÈSE.

THIS enormous building, devoted to somewhat feeble imitations of Spanish bull fights, has been recently covered in, and in order to make use of the edifice at night, either for bull fighting or for concerts, lighting by electricity has been introduced.

The arena is circular, and has a diameter of 197 feet; the dome which covers this springs from iron columns 98 feet in height, surrounding the arena. From the ground to the centre of the dome is 190 feet. The exterior of the building is in shape a 30-sided polygon, described on a circle whose diameter is 328 feet. There is seating accommodation for 22,000 persons. Light ironwork supports the glass of the dome, the central portion of which can be bodily raised between 12 and 13 feet, so as to ventilate the building in summer. The movable portion of the dome has a diameter of 98 feet. At night, the principal source of light comes from just below the movable roof, that is to say, at a height of 197 feet. Here is a sunlight of the Patin type, and, in addition to this, a circle of 150 arc lights are arranged round the dome, the total lighting power being thus brought up to 30,000 candles. The two galleries are each provided with 60 Cance incandescence lamps of 32 candles, and the ground floor passages are lighted by 16 Cance incandescence lamps of 100 candles each, and 16 arc lamps, Patin type, of 8 ampères. The offices and dressing rooms are supplied with 200 incandescence lamps of 16 candles.

Especial attention has been paid to the arrangement, fitting, and construction of the engine, boiler, and dynamo rooms, with the result that they are in reality works of art, and will no doubt produce the effect of not only familiarising numbers with electric lighting, but also of increasing public confidence in this method of illumination, and of extending its application.

There are three Collet boilers, each supplying 3,300 lbs. of steam per hour. One of these boilers is kept in reserve, while the other two feed a Powell engine of 300 H.P., and a compound Chaligny engine of 100 H.P.

The alternating current is produced by a Ferranti dynamo of 3,000 lamps, and 4 Gramme machines of 200 lamps at 8 ampères.

There is also a battery of accumulators for feeding the relief lamps in case of accident to the main lighting.

REVIEWS.

The Year Book of Commerce. Compiled under the authority of the London Chamber of Commerce, and edited by KENRIC B. MURRAY. London: Cassell and Co.

This is the second of the series of yearly volumes, prepared specially for business men, by the London Chamber of Commerce, with the object of showing the movement of the foreign trade and general economic position of the leading countries of the world. The volume, as compared with the former issue, gives additional statistics on a variety of topics of considerable value. In tables, now printed for the first time, information is given as to British trade with European countries under commercial treaties, with the increase of their population, and trade movements in 1888 as compared with 1860, international telegraph statistics, the progress of British trade since 1855, with quinquennial averages, rates of wages, trade of some of the South American States, China and Japan, and several others. With reference to the first-named table, the editor remarks that it affords most appropriate food for thought at the present moment. "This gives at a glance population and trade statistics of 17 European countries or states, in addition to the United Kingdom, with a record of the date of coming into force of the respective commercial treaties of Great Britain with them. Upon the total statistics the increases per cent. of population, of total imports and exports, of imports into the United Kingdom from, and exports from the United Kingdom to, the various countries are, as far as obtainable, stated in each instance. The illustration thus afforded is one which every business man can appreciate, and which points its own moral. At this juncture it has exceptional importance. The Continent of Europe seems destined, in 1892, to be involved in a rearrangement of its Customs tariffs of a wholesale nature. What France is inclined to do in that year, when all her principal commercial treaties expire, has been made very evident, and there, at any rate, there is little hope of a relaxation of the State-imposed barriers to commercial intercourse. Following in the train of the French treaties, most of the European States will be obliged to reconsider their position. It is therefore worthy of being noted that as far as British commerce with Russia, Sweden, Norway, Denmark, Holland, Belgium, Germany, Switzerland, and Austria-Hungary is concerned, it is regulated by treaties terminable upon a year's notice, which may thus be given early next year to expire in 1892. The British commercial treaty with Roumania terminates in July next; the treaties with France and Italy on February 1st, 1892; and those

with Spain, Portugal, Montenegro and Bulgaria at various dates in 1892. Consequently the position is one which cannot be ignored, and that it is realised by Her Majesty's Government is shown by the appointment of a Special Consultative Committee, in connection with the Board of Trade, to 'consider the approaching expiration of various commercial treaties, the probable effects upon British trade of such expirations, and the arrangements which may or should be made in lieu of those treaties.'"

Magnetism and Electricity: A Class Book for the Elementary Stage of the Science and Art Department. By J. SPENCER, B.Sc., Head Master, Science Department, Bradford Technical College. London: Percival & Co., King Street, Covent Garden.

The method adopted in this book of arranging the whole of the matter in a series of experiments has much to recommend it, as it appeals very forcibly to the student, but beyond this point there is but little to call for notice in the work, as it has no marked superiority over other excellent treatises which exist. The general arrangement of the matter is satisfactory, the illustration clear and fairly good, though, as is usual with teachers who have had no, or little, practical experience, descriptions of practical applications are exceedingly absurd; witness the description and illustration of an electric telegraph on page 135. Although we cannot highly praise the book for being written "to supply a want," we can at least say that those who purchase the same for the purpose of learning about electricity and magnetism will, if they carefully go through the whole course of experiments, obtain very thorough instruction in the elements of the subjects.

Sound, Light and Heat.

This book, by the same author and publisher as the foregoing, is a companion to the above, and does not call for any special remark. It is undoubtedly a handy volume.

Practical Inorganic Chemistry. Elementary Stage. By E. J. COX, F.C.S., Head Master of the Technical Science School, Birmingham. London: Percival & Co., King Street, Covent Garden.

This class-book is intended for the use of students preparing for the examinations of the Science and Art Department in the elementary stage of Practical Inorganic Chemistry. The whole arrangement of the book is exceedingly simple and thoroughly practical. The diagrams, which conclude the work, are very clearly drawn.

Elementary Manual of Magnetism and Electricity. Specially arranged for the use of First-Year Science and Art and other Electrical Students. By ANDREW JAMIESON. London: Charles Griffin and Co., Exeter Street, Strand.

This volume is a republication of the three manuals on "Magnetism," "Voltaic Electricity," and "Electrostatics," which we have noticed in a previous review; to the latter we have nothing to add, except to say that the complete volume forms an excellent elementary treatise on the subjects of electricity and magnetism, very practical in its arrangement, and possessing sufficient points of novelty to justify its publication.

THE WALKER AMMETER AND VOLTMETER.

ALTHOUGH there is at present a very large number of measuring instruments for electric light stations upon the market, embodying in their construction a great variety of principles, the one which is herewith described is somewhat different from most heretofore brought into use. There can be no doubt, says the New York *Electrical World*, that there is great need of a cheap and accurate instrument which is easily calibrated, and the scale divisions of which are of equal length. An instrument which would seem to fulfil these conditions is illustrated upon this page. It is the invention of Mr. G. W. Walker, of this city, and in its construction he has made use of the principle which he has already utilised in his recording meter, described and illustrated some months ago in our columns. In its design Mr. Walker has endeavoured to provide a meter containing the fewest possible number of parts, and these of the simplest character consistent with accuracy and durability, and at the same time to reduce the cost of construction to so low a figure that the instrument could be placed upon many circuits which are now unprovided with meters, because of the large expense necessary in securing a satisfactory one.

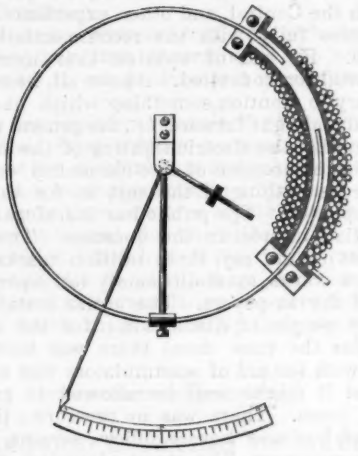


FIG. 1.

Fig. 1 shows very clearly the construction of the meter and all of its parts. A solenoid magnet of arc shape is secured in position against a suitable support by means of screws. A circular core of iron, somewhat hardened, and extending over about 270 degrees

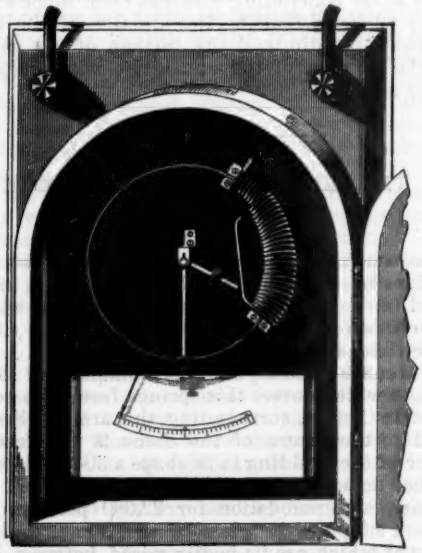


FIG. 2.

of circumference, is carried upon a bar, which is pivoted at the centre of the instrument, and swings in jewelled bearings. The needle or pointer of the instrument is also carried upon this same axis, and extends outward beyond the core to the reading scale, as shown in the figure. An arm which is threaded to receive a nut-like weight, as shown in the figure, is carried from the same centre, and by means of this the core may be balanced, so that when the instrument is not in circuit,

the pointer will stand at the zero of the scale. The solenoid is composed of a curved non-magnetic tube, and a helix of insulated wire wound upon the tube, which serves only as a support, so that it tapers or decreases in diameter from one end to the other, either gradually or by steps.

The core is made of comparatively hard iron, its free ends being joined by some non-magnetic material, such as brass, for the purpose of support, so that the core may be kept in a perfectly circular form. The ends of the core are arranged so as to stand within the coil when in a normal position. The upward end, however, may be made to stand without the coil, but within the field of repulsion of the magnet, the other end standing when in a normal position at a point about midway the length of a coil. By using a core of small diameter, it may be saturated by a slight percentage of the current used in the meter. The fact that the pointer moves over equal divisions on the scale for equal increments of current passed through the instrument, is attributed by Mr. Walker to the fact that the core, instead of being of soft iron, is somewhat hardened, and also to the fact that the coil which exerts the attractive and repellant influence upon the core is wound in the tapering manner described above.

Fig. 2 shows the instrument completed. The same construction, with the exception of the substitution of a fine wire of high resistance for the solenoid, makes the instrument a voltmeter instead of an ammeter, and both of these instruments are now made by the Walker Electric Company.

POLARISING CONDITIONS IN A GALVANIC BATTERY.*

By PROF. A. E. DOLBEAR.

WHEN hydrogen accumulates upon one of the plates of a galvanic battery so as to reduce the current, the cell is said to be polarised, and various methods have been devised to prevent this, some chemical, as in two fluid cells, and some physical, as when the plate is rotated, and these are called depolarisers; the idea being that the polarisation itself consists simply in the accumulation of gas upon the plate. I do not know that any attempt has been made to explain the underlying conditions present where chemical action is present or latent in a battery, which bring about such a result, for it is plain that such a result must have some antecedent physical conditions that determine it.

The following explanation has seemed to me to be probable, and the commendations of a number of my electrical friends induce me to publish it, not as proved, but as a step towards a clearer understanding of the mechanical conditions present in a galvanic battery.

When a piece of zinc is immersed in water it is found to be electrified, and its potential may be measured by a suitable electrometer.

Now, we know from purely chemical sources that there is chemism, or chemical attraction, existing between zinc and oxygen, and that under favourable conditions zinc will be oxidised. This so-called affinity of zinc and oxygen is not suddenly created by their juxtaposition under certain circumstances, but exists all the time, only waiting for an opportunity to show itself.

What then are the real conditions present when a piece of zinc is immersed in water? The zinc is a solid, the molecules cohere, and there is a certain degree of rigidity to the molecules. With the water it is different. As a fluid, the molecules are free to move about among each other with but little internal friction. As the molecule of water is made up of both oxygen and hydrogen, it may have an oxygen side and a hydrogen side, in which case, if there be any selective agency acting more upon the oxygen part of the molecule than upon its hydrogen part, and if the molecule as a whole is capable of shifting its position easily by a simple rotation upon any axis, as is true in this case, then all the molecules of the water that come in contact with the zinc must be oriented by the zinc so that the oxygen side of the molecule faces the zinc at every point, and consequently the hydrogen side is away from it. This would be a true polarisation of the molecules of water, and the distance to which it would extend would depend upon the strength of the chemism between the two acting elements. Such a chemical field might extend indefinitely.

When a piece of carbon or copper or other element is placed in water, it exhibits similar electrical property, but different in degree from that of zinc; so similar polarisation of molecules would be set up about it. The difference in the degree of chemism between the two elements and the oxygen of the water would determine the rate of oxidation under given conditions, and this difference we call the electromotive force of the cell. Also, the mere fact that there was a difference in this particular between the two immersed elements would tend to produce between them a similar condition of arranged or polarised molecules.

All this might be expected to occur, whether there was a chemical reaction or not, that is to say, whether or not the zinc was dissolved and water decomposed. Whether this happens, or nor, depends upon the degree of tension represented by the difference in the so-called chemism between the two elements, which difference we measure in volts, and needs to be about 1·5 for water.

If other solutions than water be used, the same mechanical conditions and arrangements would be present, differing from it only in degree.

The substance of the idea is this, that the chemism existing between the zinc and the element oxygen in the water *compels* the molecules of the water to turn so as to present their oxygen side to the zinc, which they are able to do freely, because such movements are not subject to appreciable friction in the liquid.

When the other battery element cannot combine with oxygen in any degree under the existing conditions, as when carbon or platinum is used, then only hydrogen will be set free, as there is a greater stress for the oxygen at the other element, and there must be an exchange of partners among the molecules along the whole line between the elements, according to Grothüs's hypothesis; so that, underlying the accumulation of hydrogen called polarisation, is a real polarisation in which all the molecules are facing one way from the mechanical necessities present.

It seems not unlikely that this condition of things in a heating liquid might be observed by noting the effect produced by it upon a beam of light transmitted through the liquid, especially upon reversal of electrical condition.

* The *Electrical Engineer*.

THE PROPOSED PACIFIC CABLE.

THE project of connecting Australia with Canada by a cable across the Pacific Ocean has now been before the public about 10 years, having been first suggested by Mr. Sandford Fleming in a report submitted to the Dominion Parliament in 1880. As a practical question, however, the history of the proposal may be said to date from 1887, when a conference of delegates from various parts of the British Empire was held in London. At this meeting the plan was fully explained by the delegates from Canada—Mr. Sandford Fleming and Sir Alexander Campbell—and aroused a great and for the most part a friendly interest. At the same meeting there was also revealed the fact that the project had a strong opponent in the Eastern and Eastern Extension companies, which now control the telegraphic communication between Australia and Great Britain, and enjoy a monopoly which would be destroyed if telegrams could be sent across the Atlantic, then through Canada, and then across the Pacific Ocean to Australasia. The conference adopted a resolution declaring "that the connection of Canada with Australasia by a direct submarine telegraph across the Pacific is a project of high importance to the empire, and every doubt as to its practicability should without delay be set at rest by a thorough and exhaustive survey." The favour with which the idea was received appears to have alarmed the existing companies, for last summer they endeavoured to make an

arrangement which would have given their monopoly a new lease of life. They offered to reduce their cable rates one-half on condition that the Governments interested would give a guarantee equivalent to about £54,000 a year. The Australian colonies were willing to enter into this arrangement, but Great Britain and New Zealand declined to share in the guarantee, and there the matter stands to-day. In the meantime Mr. Sandford Fleming took the opportunity to explain the Pacific plan, and it will be convenient at this point to state the nature of the arguments which he used. It was contended by Mr. Fleming that the guarantee asked for in consideration of the reduction of the rates of the old company, namely, £54,000 a year, would be equal to the annual charge upon the capital required for the construction of a cable from Canada to Australia. The length of the cable necessary to stretch across the Pacific from Canada to New Zealand and Australia is estimated by competent authorities at 8,900 miles, and Mr. Fleming says that the outside cost of a cable of the very best type would be £1,800,000. Three per cent. upon this sum would amount to £54,000 a year. It is further pointed out that the building of the Canadian line would reduce the cost of messages from England to Australia to one-fourth what they are now, while the proposal of the existing companies is to reduce them by only one-half. The length of the line is not so formidable an obstacle to the success of the project as may at first sight appear; for owing to the presence of a number of stations in the Pacific, the longest stretch would be about 2,700 miles, the others ranging from 1,200 miles upwards.

So far as we can judge, the Australian colonies and Great Britain would stand to gain by the construction of a line which would destroy the monopoly of the old companies, effect a great reduction in rates, and give them a telegraph route lying entirely in the Atlantic and Pacific Oceans and in Canada, and therefore much less liable to be interrupted by an enemy than a route following the old lines of commerce. Canadians, of course, would take a friendly interest in a project which would benefit our sister colonies and Great Britain, and the question of Canada assuming any, and if so what, share of the expense of the scheme may safely be left for future consideration. It will be seen at once that her direct interest in the matter is not so great as that of Australia and England, the volume of business between those two countries being vastly greater than the volume of business between Canada and Australia. It is to be presumed that the promoters of the plan recognise this fact and would expect Canada to bear a corresponding small share of the expense. It is quite possible that in the future new conditions may arise which will greatly enhance the importance of the project from a Canadian standpoint. Her commerce upon the Pacific, now in its infancy, may grow to large proportions, especially if the statesmen of the future age are wise enough to adopt a policy which will promote instead of hindering the growth of commerce. In such a case the construction of a cable across the Pacific would be a matter not merely of importance but of necessity. From the imperial standpoint the importance of having a line from England to her Eastern possessions, laid wholly in the open seas and in countries under the British flag, would undoubtedly be of great importance; and to this aspect of the case British statesmen will no doubt give due consideration. —*Globe*, Toronto.

ELECTRICAL TRADES SECTION.

A MEETING of the section was held at Botolph House on Monday last, Mr. R. E. Crompton in the chair.

THE BOARD OF TRADE RULES.

The Chairman said, in reference to this matter, it had been left to him to prepare a formal document and submit it to the Council of the Electrical Engineers. He had been unable to carry out these instructions as no meeting of this body had taken place; however, he met the chairman and the secretary, but the result was not satisfactory, in so much as the president said he preferred that the initiatory action should be taken by the Electrical Section, who might submit to the engineers and the Board of Trade a formal letter stating that the rules were anomalous and a hindrance to the industry. Considerable energy had been spent by Mr. Wharton, Mr. Sellon, Mr. Gray and himself in having the conditions altered; they had privately sent to the Board of Trade two memorials, and he considered if one on the top of these came from the section it would probably move them in the matter. The situation was extremely critical; his firm, Messrs. Wharton and the Brush Company, had at the present moment installations running, the overhead wires of which were not in accordance with the Board of Trade rules, and it was impossible to make them so. They took objection to two rules, one of which said that every wire, whatever its thickness, should have a rubber or material to the thickness of one-tenth of an inch outside the copper, outside that there should be the usual protection of braiding. The Silvertown people informed him that if this rule were enforced, a wire to carry the smallest high pressure current for town lighting or transmitting power, would cost £70 to £80 per mile. The wire which was guaranteed by the Silvertown engineers cost £28 per mile, such a monetary burden therefore, would in most cases prohibit electric lighting. Another objectionable rule was that which laid down that it was absolutely necessary in all cases to use suspenders. This, again, would further increase the cost, and under those circumstances there could be little extension of electric lighting. He spoke as one who knew, as he had 39 miles of conductors in Chelmsford which were put up before these rules were made. It seemed as if Major Cardew wanted safety at any price, no matter whether it prohibits electricity or not. In reply to Major Flood Page as to whether there was additional safety in these rules, he said it was quite the contrary, for when a wire was covered with a thick coating, it was difficult to centralise, there was more liability of the insulation being cut, and it was more liable to tear. The Silvertown company had paid special attention to this subject and it was claimed that their wire was perfectly safe; even Major Cardew admitted this, but when he got back to the Board of Trade office he made rules which are quite different. He considered the whole system of the Board of Trade unsatisfactory. The committee of the Electrical Engineers, who were responsible for the rules, were not practical men, and he held that they could not therefore draw up suitable rules.

After further discussion it was decided that Mr. Crompton should wait upon the Council of the Chamber of Commerce to see if pressure could be brought to bear on the officials of the Board of Trade, in the event of this not having effect, questions will be asked in the House of Commons.

THE QUESTION OF CORRESPONDENT.

Mr. Garcke said he and Major Flood Page undertook to bring forward a scheme dealing with this question. After referring to the loss sustained through the resignation of Mr. Trotter, it had struck them some new arrangement might be made, and it was that the chairman and the two vice-chairman should constitute themselves a kind of working committee, and if the Chamber of Commerce provided them with a junior clerk, pressing matters would receive efficient attention. It would practically resolve itself into an executive committee who would meet at intervals and report to the committee of the section the work done between the meetings.

INTERCHANGE OF INFORMATION.

Mr. Crompton had prepared a circular letter and tables which it was proposed to send to those who became members, for the purpose of supplying information as to cost of maintenance of stations and working expenses. This scheme was referred to by us in a recent number.

It was decided that copies of the tables should be sent to all members of the section for suggestions.

After Mr. Murray had referred to the expiration of many of the tariffs in 1892, the meeting terminated.

ELECTRIC LIGHTING IN PARIS.

WE take the following statistics as to the progress of electric lighting in Paris between the years 1885 and 1889, from the *Lumière Electrique*; the figures given refer to electric lighting by the municipality:—

Year.	Number of lights.	Systems.	Employed.	Number of fires caused by electricity.
1885	68	14 Lontin ...	Place du Carrousel	1
		12 Jablochkoff ...	Parc Monceau.	
		40 Brush ...	Parc des Buttes-Chaumont.	
		2 Siemens ...	Champ-de-Mars.	
1886	66	14 Lontin ...	Place du Carrousel	4
		12 Jablochkoff ...	Parc Monceau.	
		40 Brush ...	Parc des Buttes-Chaumont.	
1887	63	14 Lontin ...	Place du Carrousel	2
		12 Jablochkoff ...	Parc Monceau.	
		37 Brush ...	Parc des Buttes-Chaumont.	
1888	65	14 Lontin ...	Place du Carrousel	3
		12 Jablochkoff ...	Parc Monceau.	
		39 Brush ...	Parc des Buttes-Chaumont.	
1889	393 Arc lights.	14 Edison ...	Place du Carrousel	33
		40 Popp ...	Boulevards, Concorde to Opera.	
		37 Edison ...	Place de l'Opera to the Porte Saint-Denis.	
		27 Marcel Deprez	Porte Saint-Denis to the Place de la République.	
		6 ?	Place Clichy.	
		12 Jablochkoff ...	Parc Monceau.	
		47 Brush ...	Parc des Buttes-Chaumont.	
		186 Various ...	Halles Centrales.	
		24 ,, ...	Halles Centrales.	
	6188 Incandescence lamps.	85 Edison ...	Galleries of the Palais-Royal and the Théâtre Français.	
		16 ? ...	Parc des Buttes-Chaumont.	
		1000 ? ...	Reception rooms of the Hôtel de Ville.	
		1300	Council, board rooms, and and offices of the Hôtel de Ville.	
		500	Basements of the Halles Centrales.	
		287	Private service.	

NOTES.

Lighting of the Ménagère.—An important electric light installation has just been completed in Paris at the well-known warehouses and shops of La Ménagère. The current is supplied from the station of the Parisian Power and Electric Lighting Company, situated in the Rue des Filles-Dieu, and the installation has been put up by the Electric Lighting and Apparatus Company. It comprises 110 Cance arc lamps of 8 ampères, arranged two in series, and 161 incandescent lamps of 16 candle-power. Of the arc lamps, 20 are installed in the basement, 47 on the ground floor, 22 on the first floor, 15 on the second floor, and the remaining 6 in the annexe, balcony, and a side street. The incandescent lamps are similarly distributed throughout the buildings. Each series of two arc lamps is fed from a separate circuit, having an E.M.F. of 110 volts at the switchboard, whilst the glow lamps receive current from four main circuits at 110 volts. There are two distributing switchboards arranged in the basement, one being for the arc and the other for the incandescent lamps. The main brought in from the street is divided into two cables for each pole, passing through a meter to the distributing boards. Between the meter and the main is arranged a double pole switch, so that the current may be switched on to the boards or disconnected from them, as desired. The arc switchboard is fitted with suitable cut-outs, rheostats, switches, meters, &c., whilst on the glow-lamp board there are only four main switches and four main cut-outs. The arrangement of a circuit for every two arc lamps permits of any two being extinguished, as may be desired, though this method is not so satisfactory as multiple arc distribution.

The Electric Light in Belgium.—The Belgian town of Ninove, situated about 15 miles to the westward of Brussels, is the first in that country to adopt the electric light. The concession granted to the gas company, and, by-the-way, Ninove was the first town in Belgium lighted by gas, expired on the 30th of September last, and the municipality, having decided to abandon the employment of gas, has entered into a contract for 30 years with an electric lighting company of Brussels. The lighting is to include streets, squares, and public places, as well as the supply of electric light to private dwellings. The installation comprises two large boilers, two Ridder engines of 20 H.P. each, two Siemens dynamos of 16,000 watts, and two batteries of Tudor accumulators capable of feeding 600 lamps for six hours. The distribution is effected by means of overhead wires. These are bare, of bronze, and 3·5 mm. diameter. They are carried on porcelain insulators supported by iron brackets. The public lighting consists of 120 lamps of 25 candles, mounted on the old gas lamps. For private lighting, the electric current will be supplied at 9 centimes per 100 watt-hours at a tension of 110 volts. The cost will be rather less than that of gas, which has lately been charged at Ninove at the rate of 18 centimes per cubic metre.

The Electric Light at Chagford.—A woollen factory, which has been unoccupied for some years, in this picturesque Dartmoor village, has been leased by Mr. G. H. Reed, millwright and machinist, who intends to utilise the water-power and wheel in his business, and hopes to supply the electric light to the inhabitants, using the water-wheel to work the dynamo. He gave an experimental installation last week, using Joel's shunt-wound dynamo, 100 volts 30 ampères, giving 40 16-C.P. Edison-Swan lamps. The brilliant, soft light was highly appreciated by the visitors, contrasting, as it did, most favourably with the gas supplied at Chagford. An electric lighting company is being formed, and it is expected that ere long Chagford will have a permanent installation.

City and Guilds of London Technological Institute.—The report of this institute for 1890 shows the following results of the examinations as regards the electrical subjects :—

	Number of candidates' papers in 1890.	Honours.			Ordinary.			Total.		Percentage of failures.
		1st.	2nd.	Fail.	1st.	2nd.	Fail.	Pass.	Fail.	
Electro-Metallurgy	19	1	5	3	2	2	6	10	9	47·3
Elec. Engineering—										
A. Telegraphy ...	117	17	3	3	24	23	47	67	50	42·7
B. Electric Lighting, &c. ...	256	5	16	32	66	86	51	173	83	32·4
C. Electric Instrument making	13	...	2	...	4	7	...	13	...	00·0

	No. of candidates in each subject in 1889	No. of candidates in each subject in 1890.	No. passed this year for first time.	Number, having previously passed, have this year,		
				Passed in a higher grade.	Gained a higher place in the same grade.	Gained no higher place.
Electro-Metallurgy	22	19	3	5	...	2
Elec. Engineering—						
A. Telegraphy ...	127	117	41	13	8	5
B. Electric Lighting, &c. ...	204	256	141	12	9	11
C. Electric Instrument making	15	13	12	1	...	...

	No. of candidates.	A°	B†	No. of candidates passed.	A°	B†	Percentage of failures.	
							A°	B†
Electro-Metallurgy	19	12	7	10	6	4	50·0	42·8
Elec. Engineering—								
A. Telegraphy ...	117	99	18	67	56	11	43·4	38·8
B. Electric Lighting, &c. ...	256	174	82	173	116	57	33·3	30·4
C. Electric Instrument making	13	5	8	13	5	8	00·0	00·0

° Taught in classes receiving grants on the results of the examination.
† "External Candidates" taught in other institutions, or prepared by private study.

It will be seen that a very large increase in the number of "Electric Lighting" candidates has taken place.

The Electrical Trades Union.—Mr. J. Burns, L.C.C., addressed a meeting at the Bricklayers' Hall, Southwark Bridge Road, last Saturday night, held with a view to inducing non-members to join the Electrical Trades Union. He said he regretted that a Union had not been formed before, because instead of prices and wages being increased, they had, in some cases, been reduced, and boy, girl, and women labour had been introduced. The electrical trade was still in its infancy, and the business must extend. Electric lifts, motors, trains, and other methods of transmitting power would soon be adopted, and Vestries and Town and County Councils would, ere long, undertake public lighting. With the inception of electric lighting, he hoped the men who were engaged in the electrical trade would do everything in their power to help men like himself, who were members of public bodies, and who were determined to see that in any scheme of the kind Trades Union clauses were agreed to. It was a splendid opportunity for them to do something for themselves. They could fix the rates of wages, the hours of work, and the conditions of labour under any standard they thought fair and right if they had the courage. They had a splendid future before them ; but if they did not take advantage of the opportunity, they deserved to remain in the condition they now were. Mr. Burns also pointed out to his hearers the advantages of Trades Unionism, and a resolution in support of the Electrical Trades Union was then proposed by Mr. A. J. Walker, and carried unanimously.

Siemens & Halske.—The taking over of the electrical works at Vienna, belonging to the Berlin firm of Siemens & Halske, as well as the Buda-Pest electric railway, to which we alluded last week, is now an accomplished fact. A limited company is to be formed by the Anglo Bank, Mr. Siemens becoming a managing director of the new company.

A Cable Wanted in Paraguay.—The Hon. F. J. Pakenham, British Minister to the Argentine Republic and Paraguay, says, "A want very largely felt at Asuncion is regular telegraphic communication with Monte Video or Buenos Ayres, and so with the world in general. At present (August, 1890), as in 1886, the telegraph line stops on the coast of the Argentine province of Corrientes, the missing link between which and the line in Paraguay being furnished by a person of apparently somewhat lethargic habit, whose movements on the Parana in a canoe seem rather to depend on the rule of avoirdupois, as applied to the bundle of telegrams whereof he is bearer, than to the urgency or value of the messages themselves. Doubtless, however, an improvement will be apparent in this direction ere long."

Simple Pole Finder.—In the New York *Electrical Engineer*, Mr. Arthur J. Newell publishes, as the result of some considerable experimenting, an account of a pole tester which he thinks will be of interest to many people. The invention consists in saturating litmus paper with sulphate of soda and drying. When the paper is to be used it is wetted, and on the application of the wires to be tested a red spot on a blue paper represents the positive pole; if a red paper is employed, then a blue spot will show the negative pole. Mr. Newell is probably unaware that a paper for pole-finding was brought out and placed on the market two or three years ago by Dr. Wilke, which paper has several advantages over the litmus preparation, its colour being white, finely contrasting with the rich crimson stain produced by the negative wire.

Overhead and Track Wiring for Electric Railways.—The superintendent of the Albany Railway, Mr. W. H. Cull, says that too much attention cannot be paid to overhead construction and track-wiring. The insulation of the hangers should be capable of eliminating moisture, and glass or mica has given most satisfaction. Insulation cannot be too good. The trolley wires should be divided in sections, for the greater facility in locating any fault, and, if possible, each section should have a separate feeder wire; a circuit switch at the generating station would enable the attendant to pick out the faulty section while still retaining the rest of the circuit in working order. Track wiring and ground connections are the most important factors in the operation of an electric road. The return wire should be of ample section, connected to each rail twice. All joints to be well soldered and wiped. The Albany Railway has, in addition to these arrangements, copper ground plates at intervals of 1,000 feet, and at a sufficient depth to insure their being in permanent moisture. The resistance thereby is so low that no leakage interferes with telephone circuits, neither is a metallic return requisite from the electric road to the power station more than a mile away.

Halifax and Bermudas Cable Company.—The daily journals announce that the Halifax and Bermudas Company's cable has been duly tested, and a certificate granted by the Government, who paid the first quarterly instalment last week, in terms of their agreement with the company.

Tenders Wanted.—For providing and fixing electric bells to firemen's houses at Pontypridd. Particulars of the secretary, Mr. E. W. Rees, Pontypridd.

The Coefficient of Self-Induction.—We observe that the "Henry" has been introduced into a scientific paper printed by an American contemporary as the title by which the coefficient of self-induction is to be known. Probably it will not be long before it will be disseminated throughout the scientific world as the accepted term for that coefficient.

Price of Incandescent Lamps.—In the home of free trade, England, the unfortunate monopoly in the manufacture of incandescent lamps keeps up the price of lamps to an almost prohibitive figure. In the United States, on the other hand, notwithstanding the great increase in the value of platinum, 16 C.P. lamps are selling at 44 cents each. The platinum wires now cost nearly three times what they did formerly, but in spite of this extra expense, competition compels, and the use of machinery enables, the manufacturers to quote low and still retain a profit. Red-hot hairpins should become things of the past. Brilliancy, and economy in consumption of power, will be esteemed more and more as the essential qualities of an incandescent lamp.

Telephone between Paris and London.—The French section of the telephone line and cable which is to connect London with Paris has been completed. It consists of two overhead bronze wires, parallel, and crossed at intervals to diminish the effects of inductive disturbance.

Memorandum for French Elmore Shareholders.—You paid the Foreign and Colonial Company £116,875 in cash and £66,500 in shares for the privilege of your company's existence. A few months afterwards you receive a circular from your directors, congratulating you on the fact that the Foreign and Colonial Company has arranged to hand you back £50,000 of the money you had paid them in order to add to your available working capital; you to pay equivalent to over 7½ per cent. per annum interest, and to issue debentures which presumably give the holders for £50,000 a first charge on what you have paid the same organisation £116,875 for (cash only), as well as a charge on any property your own further expenditure may create.

A Chair of Industrial Electricity at the Paris Conservatoire of Arts and Sciences.—The Minister of Commerce has just created, at the Conservatoire of Arts and Sciences, a chair of industrial electricity. The Academy of Sciences will be invited to present a list of candidates for the new chair.

Electrical Fittings.—One of our young, and therefore energetic firms of electrical engineers, Messrs. Arthur B. Gill & Co., of 4, Bombay Street, Bermondsey, S.E., writes to draw our attention to the extensive and convenient showrooms lately acquired by them at 36, Parliament Street, Westminster, S.W., for the exhibition and sale of their electrical manufactures and fittings—of everything, in short, connected with the uses of electrical energy. It is intended to keep a large stock of goods at these showrooms ready for immediate delivery, and special attention is desired, firstly, to a varied and comprehensive selection of artistic electric light fittings; secondly, to a stock of Henley's electric light wire and cables in all the leading types and sizes.

North-East Coast Engineers.—We have received the list of meetings of the North-East Coast Institution of Engineers and Shipbuilders. A good programme is promised, more of interest to shipbuilders than electrical engineers. Mr. W. C. Mountain reads a paper on "Electrical Engineering" on March 9th.

Institution of Electrical Engineers.—Among those who have accepted the invitation of the President and Council to the annual dinner on the 20th inst. are the Postmaster-General, the Attorney-General, the Presidents of the Royal Society, the Chemical Society, and the Institution of Mechanical Engineers, and the Vice-Presidents of the Institution of Civil Engineers, Sir Arthur Blackwood, the Astronomer Royal, and Dr. Coleman Sellers, one of the members of the International Niagara Commission. We understand that in anticipation of the large numbers who are expected to respond to the invitation of the President and Mrs. Hopkinson on the evening of the 19th inst., on the occasion of the President's *soirée*, the Prince's Hall has been engaged, in addition to the Galleries of the Royal Institute of Painters in Water Colours.

Personal.—Messrs. J. D. F. Andrews & Co. have purchased the goodwill and assets of the firm of Messrs. White, Romanze & Co., of Kingsbury Road, Dalston, and 3 and 4, Great Winchester Street, E.C., who have been carrying on a considerable business in the manufacture of arc lamps, switches, &c., and also telephones, type-printing instruments, and electric bells, besides having many important electric light contracts.

Long Distance Telephony in Italy.—A fortnight ago a series of experiments was conducted at the chief telegraphic office in Rome with a new telephone line between that town and Albano, a distance of 20 miles, or 40 in all, the circuit being metallic throughout. The trials were successful.

Mr. Lee Bapty Arrested.—Mr. Lee Bapty, the late manager of the Edinburgh Exhibition, was arrested at Waverley Station, Edinburgh, on Saturday night, as he was about to take his departure to the south. The arrest was made under a warrant, to prevent Mr. Bapty leaving the country until he had paid or found security for his contribution of £500 to the guarantee fund of the exhibition. Security was promptly found and he was released. Since then he has written an indignant letter to the *Standard*.

The Asbestos-Faced Valve.—We omitted to say that this article, described in our last number, will be placed on the market by the Bell's Asbestos Company, Limited.

Honours for the Compound-Winding Advocate.—Mr. Graham Murray, who so ably conducted the respondents' case in the compound winding, has been appointed Sheriff of Perthshire.

Railway Stores Wanted.—The Cheshire Lines Committee require a supply of telegraph instruments, wire, and materials. Patterns can be seen, and specifications with forms of tender obtained, upon application to Mr. S. S. Barton, Cheshire Lines, Warrington.

Anglo-American Telegraph Company, Limited.—This company has opened an office for the reception and delivery of telegrams at No. 2, Northumberland Avenue, Charing Cross, thus placing the West End of London in direct telegraphic communication with New York, Canada, and all other places in the United States, West Indies, &c.

A New Professor.—Mr. J. Swinburne has just been dubbed "Professor" Swinburne by the *Elektrotechnische Zeitschrift*. This gentleman has evidently risen in the estimation of Mr. F. Uppenborn, though he may perhaps not care much for the "promotion." Mr. Swinburne's American "professorship" is a matter of longer standing.

The Bradford Free Library.—The museum and three top landings of the staircase of this library are now provided with the electric light. The result has been eminently satisfactory, both as regards quantity and quality of the light produced. The installation consists exclusively of 16-candle incandescent lamps, which are equally distributed over the room by means of pendant wires. The installation was completed on December 23rd, 1889, and has been working without the slightest hitch ever since that date. It has been decided to light by electricity the whole of the premises.

Underground Telephony in Germany.—The results obtained with the underground telephone circuits in Berlin have been so satisfactory that the Imperial Post Office authorities are now making experiments with long-distance underground wires. There are already in operation a telephone cable between Berlin and Küstrin, a distance of 57 miles; and a line from Berlin to Hamburg, 60 miles being overhead and 25 miles underground, whilst shortly the latter will be extended to 186 miles in length. The results with these long-distance wires are said to be very favourable.

A 200,000-watt Arc Lamp.—In a recent issue of *La Lumière Electrique*, M. de Fonvielle, in describing the electric lighting of the Gran Plaza de Toros in Paris, to which we refer on another page, states that the arena is partly lighted "by a Patin arc lamp taking 400 ampères at 500 volts, giving 8,000 C.P., and absorbing 50 H.P." A representative of a contemporary has, however, failed to find this large lamp, and states that only Cance arc lamps are used to light the arena. He demands the confirmation of these extraordinary figures.

Porcelain Fittings for Electric Lighting.—Messrs. Taylor, Tunnicliff & Co., who are extensively engaged in the manufacture of porcelain fittings for the electric lighting trade, have recently completed special machinery for overcoming a trade difficulty, which will doubtless lead to very satisfactory results, and supply a want severely felt by electricians engaged in fitting up these goods with the necessary metal work. We refer to the tapping with a very fine thread the small holes in porcelain switches, cut-outs, ceiling roses, &c., thereby enabling manufacturers to fit these articles up with metal work without the objectionable metal nuts, &c., at the back of such fittings, which have hitherto been a fruitful source of mishaps.

Notice of Removal.—Messrs. Davey, Paxman & Co. inform us that they are removing their London offices to larger and more convenient premises, at 78, Queen Victoria Street, E.C.

Accumulator Traction in Paris.—The action taken about a year ago by the French Electrical Accumulator Company in putting into service several accumulator cars on the Levallois-Madeleine tramway in Paris has now been followed by the company for the electrical working of metals. This company is now exploiting a tramway between the Palais de l'Industrie and the Place de la Concorde by means of a storage battery car fitted with Laurent-Cely accumulators. A noteworthy feature is that the car runs upon a Decauville tramway of the 2-foot gauge. The car is mounted upon two axles, and carries two Hillairet motors of 6 H.P. each. Each motor drives, by means of gearing, one of the axles, the reduction in the speed being in the ratio of 10 to 1. The battery consists of 64 cells containing 11 plates. These cells are placed in eight boxes, and the total weight of the car, without passengers, is 4½ tons. By means of a suitable switch the cells can be put in series or in parallel. On starting the car the current discharge is 90 ampères, and in ordinary running the consumption is 45 ampères.

The Woking Electric Supply Company.—This company has commenced operations, and applications have been received for nearly 700 lights. The Electric Trust erected the station and supplied the plant, and the whole of the electrical arrangements were designed and carried out by Mr. J. Appleton, of Guildford and London. The provisional order enables the company to charge 10d. per Board of Trade unit for electric current, but the price has been fixed at only 8d., being equivalent to about 8s. per 1,000 feet of gas. The company has made provision for using the light from half an hour before sunset until midnight, but as soon as it finds that there is a demand for light at a late hour, it will be prepared to extend their time of running.

The Pacific Cable.—In a former issue we mentioned that Sir John Pender was reported to have announced his intention of visiting Hong Kong, next year, *viâ* Canada, and of interviewing, *en route*, Mr. Sandford Fleming. The following is an extract from his letter :—" . . . . . travelling by the Canadian Pacific line, when I hope to inspect that wonderful undertaking in which you have played such a prominent part, and at the same time discuss with you the best means of establishing closer telegraphic communication between Canada and the Australian Colonies, when the time is ripe for carrying out the work." . . . . . "If the various governments interested are determined to have a line across the Pacific, and are prepared to incur the requisite expenditure for the purpose, I am quite ready, as I have always told you, to co-operate in carrying out the work on fair and reasonable terms. In this way the object might be obtained more easily and economically than if third parties were employed." There is a charming frankness and *naiveté* about this last remark which will no doubt commend itself to the "third parties" ; and we would ask how long is it since certain persons have become converted to the belief that no insuperable physical difficulties stand in the way of laying a cable across the Pacific Ocean ? Mr. Fleming, in his reply, is reported to have said that the means taken to establish the new telegraphic communication are entirely secondary, provided the new lines be secured.

The Lane-Fox Patents.—Some of our readers will be interested in an advertisement appearing in the centre of this paper, with regard to the subject of which we are given to understand that the only claim which the Lane-Fox Electrical Company has so far decided to enforce has been based on Mr. Lane-Fox's leading patent, No. 3,988** of 1878. But this moderation was largely misunderstood, and attributed to different motives ; and as the company also finds a disposition amongst certain members of the trade to evade the matter at issue rather than to meet it fairly, the Lane-Fox Company has now determined to anticipate such attempts by enforcing the claims based upon letters patent No. 4,626 of 1878, for the use in connection with its system of shunt "electro-meters," that is to say, of the class of instruments commonly known as voltmeters or potential electro-meters, with or without automatic attachments. We may also call attention to a slip of the pen in Mr. Lane-Fox's last letter to us, by which it is dated October 4th, by mistake for November 4th. This might lead some of our readers to look in vain for an article in the issue immediately preceding that date (October 4th).

Lighting the Guildhall.—On the occasion of the Lord Mayor's banquet at the Guildhall on the evening of the 10th inst., the hall was illuminated by about 500 incandescence lamps artistically attached to the gaseliers above the tables, and the excellent effect produced was greatly admired. The installation was carried out by the Brush Electrical Engineering Company at very short notice, and the result reflected great credit on all concerned.

Efficiency of Combined Engines and Dynamos.—The following letter from Messrs. Sautter, Harlé and Co. appeared in the last issue of a valued French contemporary :—In *L'Electricien* of November 1st are published the results obtained in recent trials, made in England, of a system composed of an Edison-Hopkinson dynamo, worked directly by a Willans engine. The satisfactory results obtained are not surprising. In France renderings quite as high are obtained. The following figures, which may perhaps be of interest to your readers, have been arrived at under the supervision of naval engineers in trials of the systems of motors and dynamos, working directly, constructed by us in 1890 for lighting the ironclad *Neptune*. They may serve for purposes of comparison. The dynamos of the *Neptune* supply a current of 75 volts and 200 ampères, or 20 electrical H.P. at 350 revolutions per minute. The consumption of steam at a pressure of 6 kg. per cm^2, instead of being 11·3 kg., is less than 11 kg. per electrical horse-power hour measured at the terminals of the dynamo. A direct trial by the Prony brake, on the motor, showed a consumption of 8·9 kg. of steam per *effective* horse-power hour, instead of 9·8 kg. per *indicated* horse-power. The consumption is therefore less than in the case quoted, and the difference will seem all the more worthy of mention when we consider that the system gives only 20 horse-power instead of 72, that the pressure of steam is 6 kg. per cm^2 instead of 8, and that the dynamo makes 350 revolutions per minute instead of 430.

Telephone Working.—Mr. J. J. Carty, of the Metropolitan Telephone and Telegraph Company, writes to us under date, November 1st, as follows :—My attention has been called to an editorial note in your issue of October 17th, referring to my remarks at the Detroit Telephone Convention, in which it is stated that I seemed to be unaware that the system of bridging bells invented by me has been in use for many years in the British Post Office telephone service, and that it is described in the *Telephone*, by Preece and Maier. I would call your attention to the fact that, as shown by the official report of the convention proceedings and all published accounts of my remarks, I did not claim any novelty for the bridging system *per se*, being well aware that it has been in use for years both in Europe and in America. My invention, however, relates to a specially designed bridging magneto bell, by means of which the talking and signalling on a line containing 20 stations equipped with this bell are equally as good as with a line containing only two stations. These results are not attainable with the ordinary form of magneto bell. The details of the construction of my bell were not described by me at the Convention, as an application for patent rights was then pending in the U.S. Patent Office. So far from their being any description of a bridging system employing magneto bells in the *Telephone*, it is expressly stated in that work that the magneto bell has not been adopted by the British Post Office for telephone work, and there is no mention in the book of any method of connecting a number of stations with magneto bells by bridging the instruments across the circuit. In justice to myself, I must request you to publish this letter in your next issue, as if your editorial statement as to the absence of novelty in my invention is allowed to pass uncorrected, it might unfavourably affect my interests in the matter of the disposal of the European rights to use the bridging magneto.

The Popp Compressed Air System.—A German contemporary waxes wroth because the commune of Rixsdorf, near Berlin, has, on the advice of an Imperial architect, resolved to introduce the Popp compressed air system for lighting and power purposes. The same journal, in referring to a circular issued from Lucerne inviting subscriptions to a proposed Popp central station in that town, asks what authorities have spoken favourably of the system.

Civilian Electricians in War Time. — In Lieut. Bradley A. Fiske's paper, published in another column, the author argues that as the force comprised by the standing regular army and navy is so small, it would only serve as a nucleus around which the fighting forces could be formed. Since the applications of electricity have extended to so many branches of military and naval arts, and have, in fact, become absolute necessities, the supply of competent officers and men, insufficient as it is in time of peace, would prove utterly inadequate in case of war. Lieut. Bradley enumerates the many and varied uses of electricity in navigation, gunnery, torpedo work, &c., and proceeds to point out where, in his opinion, the civilian could be best employed. He suggests that on board electrical torpedo launches and electrical picket boats, at fish-torpedo stations, in submarine mining both for harbour and coast defence, in addition to signalling work by telegraph or telephone, the civilian has his proper sphere. But, he adds, the civilian could also be advantageously employed on ships of war for the reason above stated—the insufficiency of a trained and competent regular staff. The author proposes that at all important ports there should be a corps of electrical engineers, drilled to some extent, and attached to and embodied with the national guard. The higher ranks would be instructed in navigation, gunnery, surveying, &c., while the lower would be taught the handling of apparatus.

The Spanish-Morocco Cables.—We understand that the contract for connecting Spain with her settlements on the coast of Morocco by submarine cables has been given to Messrs. Pirelli and Company, of Milan. It will be remembered that the original decree was withdrawn, and a new one issued, upon which the present contract has been made. Some of the conditions are slightly altered, the maximum price per mile of cable being now fixed at £160, payable in ten years by yearly instalments. The contractor during this period has to maintain the cable at his own cost. The sections between Almeria—Alboran and Alboran—Melilla must be laid and working within three months from date of signing contract; the other sections within six months. The lengths specified for each section differ slightly from what were given in the former decree. No stipulation is made as to quantity of each there should be laid, the decision on this point being left in the hands of the commission appointed by the Spanish Government.

The Telephone in France.—Twenty-eight towns in the departments of France have acquired, through their municipalities, a telephone service. In eight other towns the telephone lines are in construction, and will be completed in two months' time. Plans are being got out and surveys made for supplying 13 more towns with telephone systems. Of interurban systems there are only two actually working; there are seven in construction, and ten under consideration. Seven towns are connected with Paris by the telephone, and there are four more in course of being joined to the capital. In Algeria, the only two towns possessing the telephone are Algiers and Oran.

The Late Electric Light Accident in Paris.—At the last sitting of the Paris Municipal Council that body was engaged in considering the explosion following a fire in the cellars of the Grand Café. From some explanations given by the Secretary-General of the Prefecture of Police, though the enquiry is not finished, it appeared that the responsibility for the accident was due to the electric light company which occupied the underground portion of the premises. This company, the night before the accident, replaced the man who had formerly been in charge by an inexperienced man. The conclusion which the Council arrived at was as follows: The Prefecture of Police and the Prefecture of the Seine rejecting altogether the responsibility of surveillance, the Council voted the following order of the day, proposed by M. C. Laurent: "Considering to what dangers the installation of the electric light in Paris may give rise to, this body expresses a wish that Parliament, by a special law, will assimilate the electrical industry with those which are looked upon as dangerous and subjected to the incessant surveillance of the Prefecture of Police."

Electric Launch in Milan.—The Franco-Italian Industrial Electrical Company, of Milan, is demonstrating the capabilities of an electric launch in the docks of the Porta Ticinese. The launch is 24 feet long by 5 feet wide, and will carry 12 passengers. It contains a battery of accumulators, and an Immisch motor of 1½ H.P., the speed of the launch being 8½ miles an hour.

The Electro-Deposition of Copper.—We have not yet had any further data on this subject from Mr. W. Stepney Rawson.

Quick Cable Service.—The following is taken from the Montreal *Daily Witness* of October 30th:—"One of our local magnates sent a cablegram to London *viâ* the Commercial cable this morning at 10.27, and at 10.40 he had a reply, just 13 minutes. In this time the message was sent from Montreal to Canso, thence to Ireland, where it was reported to London. A transaction was effected on the London Stock Exchange, the reply written and came travelling back again, reaching the sender in 13 minutes. The gentleman could scarcely credit it, but on examination of his sent message and his reply thereto found the facts to be as above."

The New Thomson Alternating Meter.—Recognising the value of a simple and reliable device for measuring current, Prof. Elihu Thomson has in the past devoted not a little attention to the design of various meters, among which probably those of the oscillating type, in which a volatile liquid is employed as the moving force, as it were, are best known. Recently, however, says an American exchange, Prof. Thomson has devoted particular attention to the construction of a meter which shall be adapted to both continuous and alternating currents and at the same time indicate not only the consumption of current, but give it in the value of the pressure on the mains; in other words, a power or wattmeter. The manner in which Prof. Thomson has worked out this problem is highly ingenious and is apparently based on simple principles. The problem to be solved evidently was to construct a motor in which both the pressure and the current should be the factors determining the speed and a device embodying a retarding force which should vary in the direct ratio with the speed of the machine. The relative disposition of field and armature of the motor and their connection with the working circuits fulfils the former conditions, while the disposition of the copper disc retarded by the encircling magnets fulfils the second. With constancy of magnetism assured in the permanent magnets and friction reduced to a minimum, as it appears to be in this instrument, its accuracy ought to be very high. Not the least interesting point in connection with it is the quality it possesses, as exhibited by the curve, of affording practically uniform readings for both continuous and alternating currents. We hope to illustrate this apparatus in our next issue.

New Study in Natural History.—In a letter to the New York *Electrical Engineer*, "Professor" J. Swinburne says:—"We are sending the Westinghouse Company a 50 lighter (transformer) to test. In a few weeks the Westinghouse advertisement will read, 'It will pay you to throw away our converters and substitute the Hedgehog make.'" This animal is an amusing little cuss.

The New Electric Railway.—It is stated that the new City and South London Electric Railway, which was formally inaugurated by the Prince of Wales a few days ago, will be opened to the public on the 26th inst. Let us hope, however, that no premature start will be made. Better wait several weeks longer if any uncertainty exists, for any little hitch, which can readily be overlooked on an inauguration day, will not, if allowed to occur in actual working, meet with the same sympathetic feeling from the travelling public.

Electric Lighting in Germany.—According to statistics there were 21 central electric lighting stations in Germany in the year 1889. The horse-power employed is given as follows; Barmen, 600; Berlin, 10,000; Brunswick, 2,000; Bremen, 600; Breslau, 500; Cologne, 500; Darmstadt, 450; Dresden, 500; Eberstadt, 100; Elberfeld, 325; Ems, 100; Frankfort, 1,000; Gærlitz, 450; Halle, 550; Hamburg, 1,200; Kœnigsberg, 300; Zubeck, 300; Magdeburg, 500; Mulhausen, 300; Olmütz, 300; Strasburg, 400; the total amounting to 20,975 H.P.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

International Okonite Company, Limited. — The statutory return of this company, made up to the 23rd ult., was filed on the 30th ult. The nominal capital is £340,000, divided into 11,334 ordinary, 11,334 preference, and 11,332 vendors' shares of £10 each, the latter being considered fully paid up. Upon the ordinary and preference shares £7 per share has been called up, the calls paid amounting to £147,187 17s. 6d., and unpaid to £11,488 2s. 6d.

S. Z. de Ferranti, Limited.—An agreement of 30th June, filed 25th ult., provides for the purchase by the company of the business of S. Z. de Ferranti, carried on at Charterhouse Square, at Deptford, and at St. Benet Chambers, Fenchurch Street. The purchase consideration is £99,930, payable as to £19,930 in fully paid preference shares, and £80,000 in fully paid ordinary shares.

Stamford Hill, Tottenham, and Edmonton Electric Light and Power Supply Company, Limited.—The name of this company has been changed to the West Metropolitan Electric Light and Power Company, Limited, in accordance with a special resolution passed at a meeting of the members held on the 21st ult., and confirmed at a meeting held on the 5th inst.

Woodhouse and Rawson United, Limited. — The annual return of this company, made up to the 24th ult., was filed on the 6th inst. The nominal capital is £350,000, divided into 40,000 ordinary and 30,000 preference shares of £5 each, the whole of which are taken up; 8,564 ordinary and 9,936 preference shares are considered as fully paid up. Upon 31,436 ordinary shares £2 10s. per share has been called up, and upon 20,064 the full amount has been called. The calls paid (including £85 paid in advance, amount to £178,826 10s., and unpaid to £180. Three ordinary and 20 preference shares, upon which £11 10s. has been paid, have been forfeited.

Crossley Telephone Company, Limited.—The annual return of this company, made up to the 25th ult., was filed on the 5th inst. The nominal capital is £100,000, divided into 5,000 "A," 12,500 "B," and 2,500 "C" shares of £5 each. The shares taken up are 607 "A," 120 "B," and 350 "C," all being fully paid up.

Taunton Electric Lighting Company, Limited.—An agreement of 28th ult. (filed 6th inst.), cites that the Laing, Wharton, Down Construction Syndicate is now supplying to the company, certain plant and machinery for the company's new depôt at Taunton and for other works connected with the company's lighting operations at Taunton, the total cost of the same being £1,230. It has been arranged that one-half the amount shall be paid in fully paid shares of the company, and accordingly, under this agreement, 123 fully paid shares of £5 each will be allotted to the syndicate.

Laing, Wharton and Down Construction Syndicate, Limited.—The annual return of this company, made up to the 1st August, was filed August 15th. The nominal capital is £40,000, in £100 shares. 399 shares are taken, 133 of which are considered as fully paid up. Upon 266 shares the full amount has been called and paid.

Allan Everett & Sons, Limited (metal manufacturers, electrical engineers, &c.).—The statutory return of this company, made up to the 16th ult., was filed on the 21st ult. The nominal capital is £300,000 divided into 20,000 ordinary and 10,000 preference shares of £10 each. The shares taken up are 12,000 ordinary and 10,000 preference; 4,000 of the former and 3,300 of the latter are credited as paid up to the extent of £32,000 and £33,000 respectively. Upon 8,000 ordinary shares £8 per share has been called, and upon 6,700 shares the full amount has been called. The calls paid amount to £131,000. Registered office, Adderley Street, Birmingham.

CITY NOTES, REPORTS, MEETINGS, &c.

The Western and Brazilian Telegraph Company, Limited.

THE report of the directors presented at the twentieth ordinary general meeting of the company yesterday states that the total earnings amount to £89,846 13s. 9d., as against £86,555 17s. 10d., an increase of £3,290 15s. 11d. compared with the half-year to June 30th, 1889.

The working expenses amount to £40,509 13s. 3d., as against £39,104 15s. 5d., an increase of £1,404 17s. 10d. This increase is attributable to a larger sum having been written off the steamers on account of depreciation (£1,031), to the rise in the price of coals, to the opening of a new station and to the larger volume of traffic.

Including the amount brought forward from 1889 (£3,248 16s. 6d.) and the dividend received upon the shares held in the "Platino" Company to June 30th, the balance to the credit of the revenue account is £59,970 17s. from which has to be deducted £13,220 for debenture interest, leaving £46,750 17s., of which £7,500 has been placed to the renewal fund and £5,880 to the debenture redemption fund. This leaves £33,370 17s. The directors recommend the payment of a dividend of 6s. per share, free of income tax, on the ordinary shares for the half-year, being at the rate of £4 per cent. per annum, carrying forward £5,751 7s. At the corresponding period last year the dividend was at the same rate.

Since the last half-year's report 30 "Platino" shares have been exchanged for 18 shares of this company.

The dividend warrants will be posted on November 14th.

An agreement for the absorption of the Montevidean and Brazilian Telegraph Company, Limited, will be submitted for the approval of the meeting. The undertakings are so closely allied that it is most desirable they should be brought under common control, and it is now proposed to purchase the above company by an issue of 5,300 ordinary shares of £15 each in the Western and Brazilian Telegraph Company, Limited, ranking for dividend earned after January 1st next. The agreement at present subsisting provides for the payment to that company of a percentage of the gross receipts of the Western and Brazilian Telegraph Company, Limited. This payment, forming a portion of the amount paid to the London Platino-Brazilian Telegraph Company, Limited, is a charge coming between the A and B debenture issue of the Western and Brazilian Telegraph Company, Limited. Consequent upon the arrangement now proposed, the proportion of this charge, hitherto paid to the Montevidean Company, will disappear.

The directors have the pleasure to state that after long and difficult negotiation, the Government of Brazil have authorised the

company to lay alternative cables. The thanks of the company are due to the Government of the United States of Brazil for this decision. Steps will be now taken to lay the lines immediately necessary.

The Chairman, after referring to the figures given in the report, said he would turn to what he would call the political aspect of the period under review. Shareholders would remember that when they met twelve months ago they were in a parlous condition. The Brazilian Government had absolutely refused to permit them to lay the loop cables; in face of that prohibition it was quite impossible to proceed. In other respects, too, the position at Brazil was not satisfactory. That was stating it in as mild a way as he could put it. Immediately after the last meeting there was a change of government in Brazil, and instead of dealing with an Empire, they had to treat with a Republican Government. He was glad to say their experience in regard to the loops was more satisfactory than with the previous Government. They firstly endeavoured to do all they could to obtain the support of the British Government. Lord Salisbury met them in a very fair spirit, and enquired fully into the matter, the result was in the company's favour, and they obtained the moral support of our Government. He considered it had done them a great benefit. Their representative in Brazil had been exceedingly active, and conducted the negotiations to the satisfaction of the board. With a great empire like Brazil, neither the company nor any Government could bring pressure to bear, they could only convince, and fortunately the strength of the case and the weight of the evidence did convince. He was pleased to say that they had authorised the laying of the cable. They were not to suppose that this cable would bring in any extra revenue, that was not the object, it was to enable them to fulfil their concessional obligations more effectively, and at the same time to safeguard the lines against interruptions. Then there was the forfeiture clause in the agreement, which was rendered safe by this extra cable. The special question before them that day was the purchase of the Montevidean Telegraph Company. At the present time they had an agreement with the Platino Company and the Montevidean. The latter company had a second charge upon their receipts, and if the shareholders approved, it was decided to absorb the interests in accordance with the statement in the report. In conclusion, he proposed the adoption of the report and accounts.

Mr. Earle seconded, and it was carried unanimously.

The Solicitor then read the proposed agreement, which met with the approval of the meeting, and the proceedings terminated.

The Metropolitan Electric Supply Company, Limited.

SIR JOHN PENDER presided at the third annual meeting of the company, on Friday, at Winchester House. He said: The report will have explained to you our reasons for calling you together to-day. Under the Electric Lighting Act it is provided that companies with statutory powers must present their yearly accounts made up to December 31st to the Board of Trade not later than March 25th in the year following. You will remember that our company was formed in the autumn of 1888, and we naturally made up our first year's accounts to September 30th, 1889, and our general meeting was held to confirm those accounts in December last. The Board of Trade having intimated that they expected us in future to comply with these statutory requirements above referred to, we have found it necessary to alter the period of our financial year, which will end in future on the last day of December. We shall, therefore, call you together again in the spring for the purpose of submitting to you our accounts, and our meetings will henceforth be held in the beginning instead of the end of the year. I am glad to meet you to-day, for I am anxious to place before you such information as will enable you to share with the directors the confidence which they feel with regard to the position and prospects of the company. I have always felt, as chairman of other companies, that the more we strengthen the confidence between the directors and the shareholders the more smoothly we proceed and the more satisfactory is the business conducted. When we last had the pleasure of meeting you, I stated that we were supplying current for 15,000 lights, to 58 customers. We are now supplying current for 40,000 lights, to 300 customers. I may state that this number is largely in excess of that supplied by any other company in the United Kingdom, and that it is equal to about one-third of the total number of lights supplied in London by public companies. I am informed by our manager that we hold contracts for a further 10,000 lights, and that there are many more applicants who are negotiating with us for the supply. Indeed, I may say that it has been our experience that the number of applications grows steadily with and in proportion to our number of customers. I have in my hands a table showing the monthly increase of our lighting during the present year, which will give you some idea of the steady and assured growth of our business. I can also read to you a few of the testimonials we have received expressing entire satisfaction at the supply. That is another important point. I daresay you have all heard a great many complaints about the electric supplies of other companies. We have had nothing but complimentary letters from our various customers, which gives us after all the best assurance of the rapidly increasing confidence in our supply. I think it as well that I should read the testimonials, because they are important. Mr. Augustus Harris, of Drury Lane Theatre, says:—"I have no hesitation in affirming that the electric light supplied by your company, the Metropolitan, is and has been in every way satisfactory, both as to quality and regularity." Mr. George Edwardes, of the Gaiety Theatre, says:—"In reply to your inquiry, the light you have been supplying is extremely satisfactory. There is not the slightest fault to find with it, the current being regular and the light brilliant." Mr. Kennedy, of the Exeter Hall, says:—"I am pleased to inform you that the installation of the electric light at the Central Young Men's Christian Association has proved a complete success. We are very pleased both with the continuity and the quality of your supply, and I shall be at all times pleased to afford any persons bearing your card an opportunity of viewing the light." Mr. Compton, of the Garrick Theatre, says:—"I beg to state that the lighting of this theatre is in every way satisfactory, both as to purity and regularity." Messrs. Hampton and Sons state:—"We have much pleasure in stating that the lighting of our premises upon the low tension system is most satisfactory, the whole 640 lamps giving a good steady light. We heartily congratulate you upon its success." I am just reminded by one of the directors, who is a great personal friend of Mr. Hare, of another excellent testimonial. Mr. Hare's statement as an actor was:—"I feel when I leave the theatre at night quite a different man from what I used to be when we had the gas. I find, because I breathe a pure atmosphere, that I can do my work better and more effectively, and altogether I find, even from a sanitary point of view, that it is immensely beneficial to theatres." You see I have not given you private testimonials, but those of our theatres, where it is so important that the light should not only be steady, but brilliant, and I think these evidences of what we are doing are a very striking proof of what we may expect in the future. I am now going to show you, gentleman, the state of our lights, and how they have grown. On March 1st we had 16,000 lights, on April 1st 19,000, on May 1st 21,000, on June 1st 22,000, on July 1st 28,000, on August 1st 30,000, on September 1st 33,000, on October 1st 36,000, and on November 1st 40,000. You will observe that we have passed through the summer with a very fair average, and before the end of the year I expect to see at least 10,000 lights added. A glance at the map which we have prepared will show you the magnitude of our operations. You will notice the supply stations at Whitehall, Sardinia Street, Rathbone Place, and Manchester Square, together with the vast system of underground mains that have been carried out. Upwards of 40 miles of mains have been already made, and we roughly estimate that to complete our system at least double this quantity will be required. The following statistics on the subject of our areas may be of interest as showing their magnitude and importance. The average acreage is 3,105, houses 45,451, and the rateable value £4,500,000. The report states that we have obtained powers over Paddington. This district adjoins our other areas, and therefore will form part of our general system. We have obtained an advantageous site on the canal bank, and are about to commence active work, supplying, in the first instance, from our Manchester Square station. This will enable us to supply light immediately. I may here observe that we have no intention of applying for further districts at the present time. We do not consider that we shall be justified, with our present issue of capital, in incurring further responsibility and liability. We are satisfied that our present areas are amply sufficient both in size and importance to take up all our energies, and we believe that it is equally conducive to the interests of shareholders and consumers that we should develop the resources we have already acquired. Our capital at the present moment is £500,000. When I was examined before the committee which was appointed to inquire into the general electric lighting of London, I stated that I would not be satisfied as chairman of this company until our capital became at least £2,000,000. I hold precisely the same opinion to-day, after two years' experience of the work before us. I will now describe to you, in as few words as possible, the present condition of our supply stations. Our Whitehall station has caused a certain amount of disappointment owing to the fact that the large block of buildings called Whitehall Court, which it was originally constructed to light, and which we were under contract to supply as and when required, is not being occupied quite so speedily as we might have expected. Owing to this delay, we have not been able to utilise the station to its full capacity. We were, therefore, unable to count upon this station as a source of profit during the construction of our other stations, as at one time we had hoped to do. I may state that the Whitehall Court buildings are now being let satisfactorily, and I therefore hope that before long the station will be fully taken up. I informed you at our last meeting that we had given an order to double its capacity. This contract has been carried out. The machinery is now in working order, and we are ready to cope with any demand of it that may arise. We have at this moment 19,500 lights running from this station, and I may state that we have here a plant equal to supplying 50,000 lights. I very much hope that as many shareholders as possible will take an opportunity of visiting this station, as it will enable them to realise the magnitude of our undertaking. Orders to view our works can be had at the secretary's office. From this station one of the largest installations in London—that is, Drury Lane Theatre—is being lit. The next station that I shall refer to is Rathbone Place. I have already informed you of the circumstances which led us to purchase and develop this small station, which has existed for some time on this site. The new machinery which was ordered some time ago is now fast approaching completion; indeed, it would have been finished before now had it not been for many serious difficulties which have now, I am glad to say, been successfully overcome. These diffi-

culties were of a mixed character. In the first place, I daresay you know that if a man has a house alongside any electric installation, his belief is that he ought to bleed the company to some extent, on the ground that he is inconvenienced by the vibration. We have had injunctions without number, but all those injunctions were overcome in Rathbone Place. So much confidence have we in the value of this station that three days ago we purchased by auction the long lease of the building in which this station is situated. I may state that the price paid was a most reasonable one; in fact, we are advised that it is a great bargain, and the property will yield a very satisfactory return on the outlay. I may state that Rathbone Place is a most central station, and likely to give every light required. The number of lights we are now supplying from Rathbone Place is 6,000. This number could have been very largely increased, had it not been thought advisable during the construction operations to abstain from overloading this station. Manchester Square is the next station to which we attach very great importance. It is situated in the midst of the wealthy parish of Marylebone, and promises to be one of the most lucrative stations in our districts. You may remember that at the last meeting I informed you we had made advantageous terms with the London Electric Supply Corporation, by which we took over from them the existing network of mains in the Marylebone district. We were thus enabled to supply from this station the whole of the then existing demand as soon as our machinery was ready to run. By this means, although the machinery has only been at work for a period of four months, we are now supplying 11,000 lights. It is impossible to exaggerate the difficulties which are incurred in excavating the streets of London, and in avoiding the numberless pipes already laid. I may state that the whole of these works are being executed by our own men, under the superintendence of our engineering staff, and I can safely say that this is far more economical than that of employing contractors. These works have necessarily brought us into frequent contact with the local authorities, and with the County Council, and I should like to take this opportunity of expressing publicly our appreciation of the kindness and courtesy shown to us by the officials of these bodies. Turning to our financial position, I would remind you that owing to the circumstances under which we have called you together, we have no audited statement to submit. We have, however, gone very carefully into the matter, and I have no doubt that it will be satisfactory for you to hear that even with the necessarily small amount of our revenue at the close of last year and at the commencement of this, we have every reason to believe that we have more than paid our way. We are very pleased to be able to make this statement, for the following reasons, which we are anxious that you should carefully bear in mind. Our working expenses in the past, and even at the present, are, with one exception, the same, to all intents and purposes, as they will be when we are supplying double, nay treble, the number of lights which we are at present doing. Of course, the one exception is the item of coal. Otherwise, we have, at present, an engineering staff almost sufficient to cope with the maximum output we shall hereafter be called upon to supply. Hence the increase of working expenses bears no proportion to our increase in trade, and the larger our number of lights, the greater our profit on each light. The reason which makes it necessary to employ what may, at first sight, seem an excessive engineering staff at our stations, is that it is necessary that we should have a staff in the future sufficiently experienced to accept the responsibility which a full demand will impose; and it must also be remembered that our stations require almost as much supervision and attention now as at any time. I trust that I have made this sufficiently clear to you, because it will enable you to grasp some of our initial difficulties and to appreciate the importance of the statement that we have already made, that we are making a small profit. With the present large growth of business over what it was six months ago, and with an assurance of a continuous and steady increase from the present time, we believe that we are perfectly justified in stating, as we do in the report, that we look forward to a satisfactory dividend being earned during the ensuing year. I have heard some people say that a dividend might have been expected during the present year. I think this is a little unreasonable, inasmuch as the company has only been founded for a little more than two years, and has only been in possession of its Parliamentary powers for little more than one year. During this time the works which I have endeavoured to describe to you have had to be executed, and already we are able to announce that, with an average output during the present year of, say, 25,000 lights, and with our working expenses, as I have already endeavoured to show you, almost as heavy as they will ever be, we have run at a small profit. It does not, therefore, take much power of calculation to show that we may confidently look forward to a substantial return in the near future. I beg to move the adoption of the report and accounts.

Sir Robert N. Fowler, Bart., M.P., seconded the motion.

A Shareholder asked whether he understood that 30,000 lights represented £30,000.

The Chairman: Not necessarily. We are now selling our electricity by meter, and, therefore, it may be more or may be less. We must have a year or two's experience of how the meter works out before we can give a definite answer to that question.

The Shareholder: I wanted to know what the 100,000 lights mean.

The Chairman: We cannot answer that question yet, but if you ask my private opinion you might take it at about 10s. (A Member of the Board: More than that.)

A Shareholder: We shall get a key to it if you tell us the present revenue of the company.

The Chairman said he estimated the income of the present quarter at £10,000.

A Shareholder enquired whether the company was going to supply motive power as well as the light.

The Chairman replied that light was their primary object, and the demand was such at the present time that they had no time to turn their attention to supplying the motive power.

The motion was then put, and carried unanimously.

Mr. Giles, M.P., then moved the re-election of Sir James Anderson, Mr. J. Spencer Balfour, M.P., and Sir George Elliot, Bart., M.P., as directors of the company.

Mr. Dibley seconded the motion, which was agreed.

After the re-election of the auditors, a vote of thanks was accorded to the chairman and board, which was duly acknowledged, and the proceedings terminated.

West India and Panama Telegraph Company.

IN accordance with the report published in our columns last week, the meeting of this company was held at Winchester House, on Wednesday, under the presidency of Mr. C. W. Earle. In taking the report as read, he said the report was the most satisfactory one which had ever been presented to the shareholders. It was not a very brilliant one at the best, and as long as the condition of the field remained as it is now, there was little probability, in his opinion, of its ever being a very brilliant result. Traffic receipts were slightly larger than before. Working expenses, other than repair, were less than usual. Repairs to cables were in excess of previous years, but this had the compensating advantage of their putting less to the reserve fund. They were within measurable distance of the riddance of the incubus that laid upon them in the shape of arrears of dividends on the preference shares. At the present time they owed £1 8s. 6d. per share on the second preference only, the total coming to £6,653. When they compared that with the £56,000 owed in 1884, he considered good progress had been made. At the request of the colonists, they had duplicated their lines. Although new traffic would not arise, there would not be the loss incident on interruption. The difficulty at Demerara was practically settled, and they would shortly lay a cable between Trinidad and Georgetown, Demerara. The ship, *Grappler*, was already lying in the Thames waiting for the cable. After referring to his watching the interests of the company at the Telegraphic Congress, he said traffic receipts were good and he was really beginning to have hope of a better state of things. But they must not run away with false impresssons because they were coming out of bad times. Their receipts per mile were not half the average of any other cable company. He would ask ordinary shareholders not to expect that they were going to run into dividends, for they would soon lose the Martinique subsidy, the Guadeloupe subsidy would also cease in a few years, therefore he would not foster any exaggerated notions about the value of the shares.

In answer to questions he would leave the problem of receiving ordinary dividends to shareholders themselves.

A vote of thanks to the chairman terminated the meeting.

Kelvinside Electricity Company, Limited.—This company was incorporated in 1889 to supply electricity for illuminating and other purposes in the district of Kelvinside, the principal residential suburb of Glasgow. At the request of the local authority, and in order to efficiently supply the district, the directors resolved to increase the capital from £10,000 to £50,000, and accordingly the capital has now, by special resolution of the company, been increased to the above-mentioned sum of £50,000, in £1 shares. The unsubscribed capital is now offered for subscription, payable 2s. 6d. on application, 2s. 6d. on allotment, and the balance, as required, in calls not exceeding 5s., at intervals of not less than three months. This is the only company which has powers to supply electricity under the Electric Lighting Acts in that district. According to estimates, the capital outlay for plant required for a full installation of 30,000 glow lamps will amount to £40,000.

Swan United Electric Company.—At the meeting of the shareholders, which is to be held on the 25th inst., the directors will recommend a dividend of 10 per cent. for the year ended September 30th.

An Elmore Copper Company for America.—A prospectus is announced to be shortly issued of an Elmore copper company for the United States.

Commercial Cable Company.— This company has opened a branch office at 4, Charing Cross, S.W.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 7th, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £3,979.

SHARE LIST OF ELECTRICAL COMPANIES.

Present Amount Issued.	Name.	Stock or Share.	Closing Quotation. (November 6.)	Closing Quotation. (November 13).	Business done during week ending November 13, 1890. Highest.	Lowest.
250,000l	African Direct Telegraph, Ltd., 4 p. c. Deb. Regd. and to Bearer	100	99 —102	99 —102	99½	...
1,549,160l	Anglo-American Telegraph, Limited	Stock	49 — 50	49 — 50	48⅞	...
2,725,420l	Do. do. 6 p. c. Preferred	Stock	85 — 86	85 — 86	85⅝	83¼
2,725,420l	Do. do. Deferred	Stock	13¼— 13⅜	13 — 13⅛	13 7/16	13
130,000	Brazilian Submarine Telegraph, Limited	10	11½— 11⅝	11½— 11⅝	11 9/16	11⅝ xd & bonus
84,500l	Do. do. 5 p. c. Bonds...	100	101 —103	101 —103		
75,000l	Do. do. 5 p. c. 2nd Series, repayable June, 1906	100	104 —108	104 —108	108	...
63,416	Brush Electric Engineering Ordinary, Nos. 1 to 63,416... ..	3	1½— 1⅝	1½— 1⅝		
63,416	Do. do. Preference, Nos. 1 to 63,416 ...	2	1⅝— 2	1⅝— 2		
$7,216,000	Commercial Cable, Capital Stock	$100	102 —104	102 —104		
224,850	Consolidated Telephone Construction and Maintenance, Ltd. ...	14/-	⅛ — ¼xd	⅛ — ¼	9/16	...
20,000	Crompton & Co., Limited, 7 p. c. Pref. Shares, Nos. 1 to 20,000	Stock	5½— 5⅝	5½— 5⅝		
16,000	Cuba Telegraph, Limited	10	11½ — 12	11½— 12	11⅝	...
6,000	Do. do. 10 p. c. Preference	10	17 — 18	17 — 18		
12,931	Direct Spanish Telegraph, Limited ... (£4 only paid)	5	3¾— 4¼	3¾— 4¼	4	3⅞
6,000	Do. do. 10 p. c. Preference	5	8½— 9⅛	8½— 9½		
60,710	Direct United States Cable, Limited, 1877	20	10⅛— 10⅜xd	10 — 10⅛	10⅛	10¼
400,000	Eastern Telegraph, Limited, Nos. 1 to 400,000	10	13⅜— 14	13⅜— 13⅝	13 13/16	13 11/16
70,000	Do. 6 p. c. Preference	10	14¾— 15⅛	14¾— 15⅛	15 1/16	14¾
200,000l	Do. 5 p. c. Debs. (1879 issue), repay. Aug., 1899	100	106 —109	106 —109		
1,200,000l	Do. 4 p. c. Mortgage Debenture Stock	Stock	103 —106	103 —106	104½	103
250,000	Eastern Extension, Australasia and China Telegraph, Limited	10	14 — 14½	13⅞— 14⅛	14⅛	13 15/16
320,000l	Do. 6 p. c. Debentures, repay. February, 1891	100	100 —102	100 —102		
91,800l	Do. 5 p. c. (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049 3,976 to 4,326	100	102 —105	102 —105		
325,200l	Do. do. Bearer Nos. 1,050—3,975 and 4,327—6,400 ...	100	102 —105	102 —105		
145,300l	Eastern and South African Tel., Ld., 5 p. c. Mort. Deb., 1900 redeem. ann. drawings, Registered Nos. 1 to 2,343	100	101 —104	101 —104		
198,200l	Do. do. do. to bearer, Nos. 2,344 to 5,500	100	101 —104	101 —104		
45,000	Electric Construction, Limited, Nos. 101 to 45,100	10	8 — 8⅛	7⅞— 8⅛		
19,900	*Electricity Supply Co. of Spain, Nos. 101 to 20,000 ...	5	4⅜— 5⅛	4⅜— 5⅛		
70,000	Elmore's Patent Copper Depositing, Ltd., Nos. 23,001 to 70,000	2	5 — 5⅛	4⅛— 4⅜	5⅜	4⅜
67,385	Elmore's Wire Manufacturing, Limited, Nos. 1 to 67,385 issued at 1 pm. all paid (£1⅛ paid)	2	1⅛ — 2⅛	1⅛— 2⅛	1⅞	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,000 ...(£4 only paid)	5	2⅛— 3	2⅛— 3⅛		
180,227	Globe Telegraph and Trust, Limited	10	9 — 8 13/16	8⅞— 9⅛	8 15/16	8⅞
180,042	Do. do. 6 p. c. Preference	10	14¾— 14⅞	14¾— 15	14 15/16	...
150,000	Great Northern Tel. Company of Copenhagen	10	15⅝— 16⅛	15⅝— 16⅛		
15,000l	Do. do. 5 p. c. Debs. (issue of 1881) ...	100	101 —104	101 —104	101⅜	..
230,009l	Do. do. do. (issue of 1883) ...	100	104 —107	104 —107	105	...
9,334l	Greenwood and Batley, Ltd., Ordinary, Nos. 4,667 to 14,000 ...	10	11¼— 12⅛	11¼ — 12⅛		
5,334l	Do. 7 p. c. Cumulative Preference, Nos. 2,667 to 8,000	10	11¼— 12⅛	11¼— 12⅛		
41,609	India-Rubber, Gutta-Percha and Telegraph Works, Limited ...	10	18⅛— 19½	18 — 19	18¼	...
200,000l	Do. do. 4½ p. c. Deb., 1896...	100	100 —102	100 —102		
17,000	Indo-European Telegraph, Limited...	25	35 — 37 xd	35 — 37		
11,334	International Okonite, Ltd, Ordinary Nos. 22,667 to 34,000 (£7 pd.)	10	6½— 7	6½— 7⅛		
11,334	Do. do. Preference Nos. 5,667 to 17,000 ...	10	6½— 7	6½— 7⅛		
38,348	London Platino-Brazilian Telegraph, Limited	10	6⅝— 7⅛	6⅝— 7⅛		
100,000l	Do. do. do. 6 p. c. Debentures ...	100	105 —108	105 —108		
43,900	*Metropolitan Electric Supply, Limited, Nos. 6,101 to 50,000 ...	10	5 — 5⅛	5⅛— 6		
438,984	National Telephone, Limited, Nos. 1 to 438,984	5	4⅛— 4⅜	4⅛— 4⅜	4⅜	4
15,000	Do. 6 p. c. Cum. 1st Preference	10	12 — 12⅛	12 — 12⅛		
15,000	Do. 6 p. c. Cum. 2nd Preference (£8 only paid)	10	9⅛— 10⅛	9⅛— 10⅛		
220,000	Oriental Telephone, Ltd., Nos. 80,001 to 300,000 (11/- only paid)	1	⅛— ⅜	⅛— ⅜		
9,000	Reuter's, Limited	8	8¼— 8⅜	8¼— 8⅜		
209,750	South of England Telephone, Ltd., Ordinary, Nos. 1 to 2,000, 2,501 to 3,500, 93,251 to 300,000	1	⅛— ⅜	⅛— ⅜		
20,000	Do. 6 p. c. Cum. Pref., Nos. 1 to 20,000 (£3½ only paid)	5	2½— 3 xd	2½— 3		
3,381	Submarine Cables Trust	Cert.	113 —117	113 —117		
78,949	Swan United Electric Light, Limited ... (£3¼ only paid)	5	5 — 5⅛	5 — 5⅛	5⅛	...
37,350	Telegraph Construction and Maintenance, Limited	12	43 — 45	43 — 45	45	44
150,000l	Do. do. do. 5 p. c. Bonds, red. 1894	100	100 —102	100 —102		
58,000	United River Plate Telephone, Limited	5	3 — 4	3 — 4		
146,128l	Do. do. 5 p. c. Debenture Stock... ...	Stock	90 — 94	90 — 94		
3,200l	Do. do. 7 p. c. Debs., Nos. 1 to 1,000 ...	100	... ...	... ...		
15,609	West African Telegraph, Limited, Nos. 7,501 to 23,109	10	8½— 9⅛	8½— 9½		
290,900l	Do. do. do. 5 p. c. Debentures	100	98 —101	98 —101	99⅜	99
30,000	West Coast of America Telegraph, Limited	10	4 — 5	4 — 5	4½	...
150,000l	Do. do. do. 8 p. c. Debs, repay. 1902 ..	100	102 —107	102 —107	105	104¼
64,174	Western and Brazilian Telegraph, Limited	15	11 — 11½	11 — 11¼	11 5/16	11 1/16
27,873	Do. do. do. 5 p. c. Cum. Preferred	7½	6⅞— 7	6⅞ — 6⅞	6 15/16	5⅞
27,873	Do. do. do. 5 p. c. Deferred	7½	4½— 5	4½— 5		
200,000l	Do. do. do. 6 p. c. Debentures "A," 1910...	100	103 —106	103 —106		
250,000l	Do. 6 p. c. Mort. Debs., series "B" of '80, red. Feb., 1910	100	103 —106	103 —106		
88,321	West India and Panama Telegraph, Limited	10	3 — 3½	3⅛— 3⅜	3 5/16	3⅛
34,563	Do. do. do. 6 p. c. 1st Preference ...	10	11½— 12	11½— 12	11 15/16	11⅞
4,669	Do. do. do, 6 p. c. 2nd Preference ...	10	14 — 15	14 — 15		
1,336,000	Western Union of U.S. Tel., 7 p. c. 1st Mort (Building) Bonds	$1,000	120 —125 xd	120 —127		
175,100	Do. do. 6 p. c. Sterling Bonds	100	99 —103	99 —103		
42,853	*Westmstr. Elec. Sup. Corp., Ord., Nos. 101 to 42,953 (£3 only paid)	5	2½— 3	2½ — 3	2¾	...

* Subject to Founders' Shares.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Blackpool Electric Tramway Company, Limited, £10 (£6½ paid), 7⅛—7⅜.—Elmore Copper Depositing Priorities, 7 —7⅛.—Elmore's French Patent Copper Depositing shares of £2 (issued at 10s. premium, 15s. paid), 2⅜—2⅝.—House-to-House Company (£5 paid), 4⅞—5⅛.—London Electric Supply Corporation, Ordinary (£5 paid), 2¼—2½.—Manchester Edison and Swan Company, £9 (£1 paid) 11/- —13/-.—Woodhouse & Rawson Ordinary of £5 (£2 10s. paid), 2⅛—⅜.—Preference, 4⅛—4⅜.

BANK RATE OF DISCOUNT.—5 per cent. (25th September 1890).

INDUSTRIALISM.*

By W. B. ESSON.

(*Concluded from page* 554.)

But how does this affect the workman himself? Well, generally he works shorter hours than ever he did, and the purchasing power of the wage he receives is higher than ever. Individually, or in combination with others, he is free to bargain with his employer for the price of his labour, and nobody interferes. Yet, that he is far from satisfied with his lot, is a matter of daily observation. That the employer is displeased with his profits is also made manifest. That both fail to adjust their differences amicably is a fact which continues to be emphasised by constantly recurring strikes and locks out. In June of this year, for example, there were 79 strikes recorded, in July there were 99, and in August the number rose to 105. Some of these were of considerable magnitude and importance. The dock labourers and seamen headed the list with 16. The cotton trades come next with 15; the building trades follow with 12 and the miners with 9, the remainder being divided among the miscellaneous trades. Since then strikes in the iron and shipbuilding trades have been rife. As I write† a strike in the tin-plate trade has just terminated, battalions of troops are held in readiness at Chatham to quell disturbance should the Beckton gas stokers strike, news comes that for the first time in the history of our iron manufacture all the Scotch furnaces, with the exception of those at Carron and Wishaw, are out of blast, the furnacemen having struck work. It must be remembered that each strike or lock-out is a confession of failure on the part of employers' associations or men's unions to adjust their differences in a reasonable spirit. These combinations exist for the purpose of settling labour disputes peaceably. A strike or lock-out is the last resource of either, and when this has taken place employer and employed stand related to each other as do two nations who, after vainly attempting to come to terms in the council chamber or refusing to submit to arbitration, determine to meet in the battle-field. The industrial battle, though generally a bloodless one, is inevitably disastrous, which, ever side gains, and these violent methods of settling disputes can only be regarded as constituting a virulent disease to which the industrial organism in its present stage of development is exceedingly liable. Nor can disease seize on one part of the system without producing, to a greater or less extent, functional derangement throughout the whole. A strike amongst the blast furnacemen, for instance, while it reduces the output of iron, throws upon the market a quantity of coal, which, before the strike, was used in smelting. This will make prices fall, and if the strike were long continued, would probably lead to a reduction of the miners' wages. Again, if the demand for iron keeps up, the price will rise as stocks are exhausted, and the price of manufactures in which iron and steel are employed, will rise accordingly. Owing to the rise, the demand in the shipbuilding and other iron-using industries will fall off, and the wages of those engaged in them may be in turn reduced. Of course I don't say that all these things will inevitably occur. What I mean is that the strike creates forces tending to make them happen, and which, if applied for a sufficiently long period, would doubtless have the result indicated. I use this illustration to show that every branch of industry hangs as it were upon another. Men think they are fighting the capitalist, when they are really fighting the workmen in a different branch of trade as well, and endeavouring to obtain a rise of wages partially at their expense. Emphasising this very point, there comes, while I write, the news that a thousand men are locked out in the engineering works at Newport, owing to a dispute between the smiths and boiler-makers.‡ As a matter of fact, profits and wages are derived from the same fund, employer and employed alike endeavouring to make the shares they respectively receive as large as possible.

Then outside the region of skilled labour, to which the observations in preceding paragraphs are mostly applicable, is a host of unskilled workman whose condition in many cases is, to say the least, precarious. Towards the Docks and the East-End drift this flotsam and jetsam of labour, and the attempts, successful to some extent, to form the dockers at different ports into a compact combination capable of bargaining for its services *en masse*, will be fresh in your memories. In the organised branches of this labour, however, strike has followed strike for the past twelve months in rapid succession. The Southampton riots are an affair of a month ago, and to-day steamers are lying in the London Docks with grain cargoes which corn porters refuse to unload, notwithstanding the advice of their union leaders to the contrary. The *right* of men to strike is admitted. The principle of free labour is, that if a man is dissatisfied he is at liberty to leave work and make a better bargain for his labour elsewhere. But while admitting the right, it is quite another question whether this right is being exercised to advantage or disadvantage. It seems here that the men have got quite beyond the control of the Union officers. Intoxicated with success they seem to think that there are no extremes to which they may not go. They are like an army which, in the triumph of victory, exhibits insubordination, becomes disorganised and falls an easy prey to an enemy on the watch for advantages.

That strikes are a blot on Industrialism is admitted by all, nor is evidence wanting to show that they are conducted frequently in that spirit of militancy which is inherited from more barbarous ages. Coercion and intimidation are frequently resorted to. Rioting is common, and the strikers when arguing with the recalcitrant "blackleg" are not averse to occasionally emphasising the chief points by the aid of sticks or crowbars. In fact, gentlemen, we have in the conduct of a modern strike the old aggression appearing, we have the persecution, the intolerance and the oppression bred in our bones made manifest. We have all the evil of the human nature of our time revealed, which only the discipline of centuries to come can thoroughly eradicate.

But outside organisation of any kind is a shiftless throng of humanity living in rookeries, degraded, ill-clad, and worse fed. It is almost impossible for us to conceive how these creatures exist. As you know, competition is blamed for much of the evil in the East-End, and a Sweating Commission investigated the conditions under which the poor live but a short time ago. After collecting information regarding their lives from all sources, the Commission issued a bulky report, which is practically bare of suggestion. It is, in short, an acknowledgment that for the precarious wages and the state of misery revealed, the legislature can offer no remedy. Irremediable though it may be, however, it is still a blot on the industrial system.

But trade disputes, inadequate wages and poverty, are not the only blots observable. Writing of Glasgow, fifty years ago, a writer remarked that every Saturday and for the most part of Sunday, ten or twenty thousand workmen were more or less intoxicated, every farthing which could be spared being too often converted into ardent spirits. "The same individuals, who, a year before, were reduced to pawn their last shreds of furniture to procure subsistence, recklessly threw away the surplus earnings of more prosperous times in the lowest debauchery. The warnings of religion, the dictates of prudence, the means of instruction, the lessons of adversity, are alike overwhelmed by the passion for momentary gratification."* That was written in 1840, but it is fairly true to-day. Anyone who studies closely the habits of the labouring classes in our large towns, cannot fail to be struck with the truth of Mr. Alison's observations. Improvidence, extravagance, and intemperance, are the besetting sins of the British workman. "Very few of them lay by in anticipation of times when work is slack; and the general testimony is that higher wages commonly result only in more extravagant living or in drinking to greater excess." From personal experience of workmen, I should say that in the large towns of England there is spent on an average from 15 to 20 per cent. of the earnings on beer and tobacco. Providence plays but an unimportant part in their lives. They listen to the voice of instinct and follow the promptings of unregulated desire, but for the most part lack that power of self-denial which should enable them to sacrifice present enjoyment in order to obtain future benefit. I speak of them now as a class, but that there are many exceptions to this general rule goes without saying. Nevertheless, it will be observed that the labourers' grievances are largely of their own creation. Though they talk much of co-operation, they continue to pour the possible capital down their throats or blow it in the air.

Here then is the position of things. The units composing the industrial community are exceedingly imperfect, consequently the present industrial system works imperfectly, production being hampered by continual bickerings, not only between employer and employed, but between the various sections of the latter as well. The earnings of industry after paying rent and taxes are divided into two parts, one payable to the capitalist for the loan of his capital, interest, the remainder constituting a wages-and-profits fund, which is divided between the managers and the workmen. So far as can be made out, it is the contention of the workman that the latter fund is unfairly divided, and in one or two words we may examine the conditions which regulate the division. First, however, it is necessary that the amount payable as interest be confused in no way with the amount devisible as earnings of management and earnings of labour among the producers. Though the same individual may be capitalist and manager, as often happens, the sums payable as interest and as earnings of management are to be considered quite separately. The amount due to interest is represented by the sum which the employer would get for the use of his capital if it were lent to a business man who managed a concern of the same kind as his own and having similar risks, is determined, in fact, by the market price of capital. This, as everyone knows, depends upon the demand for the use of money and the risk attending the lending of it. A Corporation whose security is excellent, can borrow readily at from 3 to 3½ per cent. But where there are various risks involved, as in most trading concerns, the borrowers have to raise money on mortgage debentures at 4½ to 5 per cent. Let it be understood that the capitalist has not fixed the amount of interest. That has been fixed by the competition for the aid of capital and the conditions under which it is lent. If the demand for the use of money is great, interest is forced up; if it gets less, interest falls. I conceive that the workman's objections are not to the interest the employer as a capitalist receives, but to the profits or, more properly, "earnings of management" which he takes from the wages-and-profits fund. Indeed, the workman by placing his savings in the bank may himself become a

* Presidential Address delivered to the Old Students' Association of the City and Guilds of London Institute at Finsbury College, November 6th, 1890.

† October 5th. ‡ October 6th.

* Mr. Alison on "Population," Vol. I., page 290.

capitalist to the extent of his means and get paid for the use of his money.

The amount due to interest being deducted then, the wages-and-profits fund remains to be divided amongst the producers. You are no doubt familiar with the saying that the amount of wages received by any particular section of the community is regulated by the supply of, and demand for, their particular kind of labour. But that there are secondary forces coming into action which, in conjunction with supply and demand, are beginning to exercise an important influence on the rate of wages must be apparent to all who have watched recent labour movements. "In an industrial conflict," said Prof. Marshall recently, "each side cares for the opinion of the public at large, but especially for that of those whose sympathy they are most likely to get; in the South Wales strike, for instance, the railway companies were specially anxious about the good opiuion of the shippers and the engine drivers about that of the colliers."* Thus we see that in addition to the influence of supply and demand the influence of public opinion is being brought to bear on questions relating to the adjustment of wages or to the distribution, if I might better put it, of the nett industrial returns. Supply and demand are, however, the great regulators, and upon these mainly the adjustment of wages depends. The capitalist is outside this adjustment. It is effected by competition among the various sections of workers for different kinds of labour; and the higher wages offered to any particular branch when the labourers become scarce in it form the inducement for others to come in, thus increasing the supply, and tending to bring the wages down to their normal level. Managers and business men are not exempt from the universal competition. If business power is scarce a proportionally larger amount is paid for management out of the wages and profits fund, and *ceteris paribus* less remains for the time being for division amongst other workers; if business power is plentiful, proportionally less is paid, and the workers temporarily benefit. If the employer is capitalist and manager at the same time the relation still holds good. True, he may pocket an apparently large sum as earnings of management, but on the other hand his enterprise, energy, ability and fertility of resource have to be paid for.

It is a common saying that a large return means a great risk, and in the case of businesses making large profits, the employer's share may very often be regarded either as the reward of genius and foresight, or as the higher interest he obtains for his capital under the exceptional risk of losing it. Competition between manufacturers in an ordinary way, however, is constantly tending to reduce earnings of management, and in bad times an employer, who is manager and capitalist as well, has very often to endure all the trouble and worry of managing his business for nothing, gaining, in the end, merely a bare interest for his money, such as could be obtained without trouble by lending it to someone else. In a joint stock concern the business is conducted by a manager and board of directors, who both receive wages of management, the capital being furnished by the shareholders. The latter receive a return as interest, and if this rises above the market rate, there are forces applied at once to bring it down to the normal in the form of new companies starting in the same business and entering into competition. What I wish to point out most clearly is that there is for each kind of labour a normal wage value, determined by the proportion which the wages in different employments bear, in order that a supply of workers in each may be forthcoming to meet the demand. Also the competition amongst the different classes, or, in other words, supply and demand, constitute the chief forces which tend to maintain wages at this normal value.

The various combinations of employers and employed have attempted to modify the relation between the wages of different labourers, but whether such combinations can effect, under present arrangements, any considerable change of a permanent character, is open to doubt. It seems to me that "corners" in labour, like corners in raw materials, are very likely to defeat their own ends, and that combinations which seek to obtain more than their proper share from the wages-and-profits fund, are unlikely to meet with other than that temporary success which adjusts their wages again to their normal level. But the present condition of industry is transitory, and only suited to the times. It represents a stage in the growth of Industrialism, and as fast as human nature changes to make a better state of things possible, just so fast will a better state be developed. "It is quite possible," as Mr. Spencer says, "to hold that when instead of devouring their captured enemies, men made slaves of them, the change was a step in advance; and to hold that this slavery, though absolutely bad, was relatively good, was the best thing practicable for the time being. It is quite possible, also, to hold that when slavery gave place to a serfdom under which certain personal rights were recognised, the new arrangement, though in the abstract an unequitable one, was more equitable than the old, and constituted as great an amelioration as men's natures then permitted. It is quite possible to hold that when, instead of serfs there came freemen working for wages, but held as a class in extreme subordination, this modified relation of employers and employed, though bad, was as good a one as could then be established. And so it may be held that at the present time, though the form of industrial government entails serious evils, those evils, much less than the evils of the past times, are as small as the average human nature allows—are not due to any special injustice of the employing class, and can be remedied only as fast as men in general advance."* And there are, here and there, signs of a higher industrial organisation. Co-operation proposed long ago a system, under which the workers are themselves the capitalists, is making progress. Profit sharing, a system which, after paying fixed wages and fixed earnings of management, allows of another distribution, *pro rata*, from the wages-and-profits fund, is, in several instances, being adopted. Only slowly, however, are these changes occurring, and several schemes had to be reported by the Labour Association in August as having "been temporarily abandoned, owing to the antagonistic attitude of the several trades unions." A most hopeful feature of this report, however, was that the question as regards the "workers sharing in losses as well as profits, had received a very practical answer from the workers of Messrs. Thomson and Sons, of Huddersfield, whose business was based on industrial partnership lines. Last year it was found impossible to pay any interest on share capital, and the workers resolved to pay interest themselves out of their own wages."† That spirit which freely recognises the claims of all, the sentiment of justice, mutual trust and mutual forbearance, are amongst the factors which will in time produce the industrial reformation.

In the course of this address I have talked of the industrial organism, and the term is not as might be supposed a mere figure of speech. In its gradual development from a simple to a complex form, in its continued differentiation of functions, in its ever-growing mutual dependence of parts, and in its increasing co-operation of members Industrialism manifests all the changes which take place in the course of organic evolution from the lowest to the highest type. And in the nature of man—the social unit—must be sought the cause of this gradual advancement. As amongst lower animals the increase of numbers and the struggle for subsistence has been the means of developing those special features exhibited by different species, so among men, the redundancy of numbers and the striving of each to gratify his desires have been developing a skill, intelligence, and self-control, which will in time lift him from savagery to the highest civilisation. That the present state of society is but transient has been already pointed out. It is the product of past and present, and represents the progress of evolution up to date. It has to be perceived that society is an aggregate of men, that it must therefore manifest in its institutions all the defects possessed by the units of which it is made up. That it is faulty in many particulars is apparent, but that it is the best—nay, that it is the only state possible for the time being, must, at the same time, be admitted. Only as fast as men, the units, advance, and as human nature improves, can a better state of society, the aggregate, arise.

People are loth to believe that institutions can only evolve, are impossible of manufacture. It is sometimes amusing to read the various manifestos of State socialists, ready with their cut-and-dried schemes to regenerate Industrialism, and professing that were their plans adopted, the traits which have characterised humanity through countless ages would forthwith disappear. And yet, perhaps, the published utterances of socialist leaders constitute the best proof that they are unfitted for a better condition of things. Men who talk of confiscating property without the slightest regard for the claims of the owners, manifest by their language their unfitness for a condition of society which implies a fuller recognition of men's rights. But some are foolish enough to believe that the passing of this or that Act would regenerate humanity, and that the men who show themselves to be guided by the instincts of robbers, are those who are to be instrumental in bringing about an industrial millenium. They have history to teach them, but they will not be taught. In olden times, the government imposed endless restrictions on industry, but one by one they have been removed, because found in time to be a mistake and discovered to intensify the evil they pretended to remedy. That the removal of these restrictions has been of immense service to industry most thinking men will admit. Nevertheless, in our day, a school has arisen which demands State interference of such a character that the restrictions of former times pale by comparison.‡ One can scarcely take up a daily paper which does not contain some attack on a State department for the perfunctory performance of its duties, and yet, notwitstanding this daily accumulating evidence, it is implicitly believed that for all evils to disappear, society has merely to be transformed into a huge government office.

That Socialism—inasmuch as the term implies complete adaptation to the social state—is the ultimate goal of society has been implied, but that this can be furthered by governments which exist because of the imperfections of humanity, is doubtful. "Perpetually, governments have thwarted and deranged the growth, but have in no way furthered it; save by partially discharging their proper function and maintaining social order. It is not to the State," quoting Spencer, "that we owe the multitudinous useful inventions from the spade to the telephone; it was not the State which made possible extended navigation by a developed astronomy; it was not the State which made the discoveries in physics, chemistry and the rest which guide modern manufacturers; it was not the State which devised machinery for producing fabrics of every kind, for transferring men and things from place to place, and for ministering in a thousand ways to our comforts. The world-wide transactions con-

* The British Association 1890 Meeting. Presidential Address to Section F.

* "The Study of Sociology," p. 253.

† See Report of the Labour Association for 1890.

‡ See The Radical Programme; Chapman and Hall.

ducted in merchants' offices, the rush of traffic filling our streets, the retail distributing system which brings everything within easy reach and delivers the necessaries of daily life at our doors, are not of governmental origin. All these are the results of the spontaneous activities of citizens separate or grouped; "* are, in fact, the results due to competition and to each one endeavouring to satisfy his own individual desires. So much has competition done; but those who have to do with Government departments know well that they are the last places in which enterprise or zeal, or even activity, is to be looked for. It will not do. The first requirement of progress is freedom of action. That everyone shall be at liberty to satisfy his desires in his own way, provided the equal liberty of others is not infringed, is the all-essential condition, for only in the endeavour to obtain their satisfactions have the intelligence and culture of modern times been developed.

I have referred to the improvidence of the working classes, but the influence which bad legislation has had in forming their improvident habits is generally ignored. As a matter of fact, they have been disciplined in improvidence for centuries, the punishment which extravagance should bring having been averted by the operation of the Poor Laws. Men have been taught that if they lack the foresight or self-denial entailed by preparation for old age, it is the duty of the State to make requisite provision for them, a premium having been thus put upon idleness, improvidence, drunkenness and licentiousness by taxing the virtuous and independent in order that the vicious might lead easy lives and multiply faster. Our State organised charity is a scandal to civilisation, but State Socialism, mark you, is but State charity on a gigantic scale. "It is a fact apparent to every thoughtful man," says a clever writer, "that the larger portion of the misery which constitutes our social question arises from idleness, gluttony, waste, profligacy, betting and dissipation. Reliance on industry, self-respect and energy, does not enter into the socialistic propaganda. In some vague way the poor man who is a voluptuous prodigal under the present order of things is to become wise and virtuous when property is held in common. But this is loose thinking which deceives no one who can think intelligently. He that is filthy will be filthy still, and he that is unjust will remain unjust in the absence of a moral change within." † All legislative attempts to equalise mankind must be futile, and not only futile, but mischievous, as their immediate effect, apart from evils more remote, is to increase the number of undeserving at the expense of the deserving. The human species obeys the laws of life by which all species are governed, and one of the fundamental generalisations of biology is, that fertility is determined by environment; that the rate of multiplication is always adapted to the conditions of existence. For every species there is a normal rate of increase, and if from any cause the relation existing between the organism and the environment becomes modified, a corresponding change in fertility results. Other things remaining the same if the conditions of life are made easier for a species, its rate of propagation increases, and from this universal law there is no escape. If the State, by relieving the citizen of responsibilities, voluntarily but imprudently undertaken, makes the conditions of his life less severe, self-reliance is displaced, self-respect is diminished and self-restraint is discounted. Relieved to an extent of the necessity for individual exertion, the rate of multiplication will rise above the normal, and only fall to it again if from increase of numbers the struggle for existence be raised to its former severity. The mean result of this interference on the part of the State is permanent increase of numbers in a lower grade of life, and permanent diminution in a higher, the struggle for existence being at the same time diminished as regards the former, and increased as regards the latter temporarily or permanently, as the case may be. Economists are fond of telling us that the "Standard of Comfort" of the people must be raised if the growth of population is to be checked. In the nature of things this means increased self-denial and a fuller recognition of responsibilities. It means an ideal which can only be realised by individual effort, a something to be by-and-bye gained by sacrifice now. The standard of comfort can be raised only by increased individuation. There is no other way. However implanted the incentive to rise must act from within and only by each progressive movement entailing more and more individuation, is the energy available for genesis diminished. The gospel of State Socialism is mere rubbish. To employ Mr. Arnold White's pithy summary, it is a gospel which equalises "genius and stupidity, industry and indolence, waste and thrift." It constitutes a removal of the forces which have operated from the dawn of civilisation till now to adapt men to the social condition. It comprises an unfitting process under which every deserving member of society gets less than the share he merits, in order that every undeserving member may get more.

From these remarks, it must not be thought that I am justifying the present state of Industrialism; far from it. My object has been simply to show that it is the best the average human nature of the time will permit of. It is a fact which must be ever kept in mind that human nature cannot be revolutionised by Acts of Parliament, nor can the evils which result from the average defects of humanity be eradicated by State measures. It is equally important to remember that human nature changes slowly, though it is utterly fallacious to assume, as some do, that it changes not at all. It is the function of the Government to protect the citizen from foreign foe and civil aggressor, to enforce justice, to remove hindrances, and permit society, with fullest freedom, to work out its own salvation. If the present were the end, economists might well close their books and admit, with Carlyle, that their science were somewhat dismal. But to those who realise that the present is but a stage in development, and that the process which has already lifted us from savagery to semi-civilisation must continue till the adaptation is complete; to those who believe that in time the traits of a bye-gone savagery will disappear, the future of humanity is full of hope. Nor are signs wanting that we are making progress. Notwithstanding the various labour battles being fought around us, I think there is, amongst the more enlightened, evidences of fuller co-operation between the various sections of industry. Both masters and men are becoming a little less selfish, and are getting to trust each other more fully. Aggressiveness on each side is diminishing, and there is distinct indication of growing sympathy between them. As a result, a great development of profit-sharing arrangements, industrial partnerships and other schemes in which active co-operation is requisite, may be looked for in the near future. In these the hopeful see the beginning of the end.

But by no legislative legerdemain is the final goal to be reached, and it is through the purgatory of competition that we must pass to an industrial heaven. Remember the social state was forced on man by redundancy of numbers. "From the beginning, pressure of population has been the proximate cause of progress. It produced the original diffusion of the race. It compelled men to abandon predatory habits, and take to agriculture. It led to the clearing of the earth's surface. It forced men into the social state, made social organisation inevitable, and has developed the social sentiments. It has stimulated to progressive improvements in production, and to increased skill and intelligence. It is daily thrusting us into closer contacts and more mutually-dependent relationships." * And with each advance in intelligence, with each demand on the increased individuation rendered imperative by the struggle for existence, there goes the inevitable diminution of fertility. "After having caused, as it ultimately must, the due peopling of the globe and the raising of all its habitable parts to the highest culture; after having brought all processes for the satisfaction of human wants to perfection; after having at the same time developed the intellect into complete competency for its work, and the feelings into complete fitness for social life; after having done all this, the pressure of population, as it gradually finishes its work, must gradually bring itself to an end." †

And here, based on history and on science, is foreshadowed a Utopia, in the presence of which even dreamers may well stand wonderstruck. From Sir Thomas More to Edward Bellamy, from Fourier to Grant Allen, the thinkers who have been struck with the misery of mankind have each in turn manufactured a system in accordance with their ideas of what ought to be. And having manufactured a system, they manufactured the human units to suit it. But they altogether ignore the power of the forces which have secured the partial adaptation to work out the adjustment to the end. That the harmony is far from complete is apparent; that man has instincts unfitted for social life is undeniable; but it is none the less sure that the process of adaptation to environment is gradually eradicating those hurtful instincts, and bringing into being emotions corresponding to complete harmony between faculties and surroundings. Nor will work be regarded in any sense a burden when this time arrives. Only pleasure is experienced by the exercise of faculties perfectly adjusted to requirements, and when the adjustment is complete, the efforts requisite for existence will constitute but a pleasurable activity. A time must be contemplated when the overflow of capital from rich countries into uncultivated or ill-cultivated regions of the earth must cease, and when for new works of vast magnitude its aid will be no longer required. Due to this lessened demand, the rate of interest will gradually fall, and the inducements to save large sums for one's personal benefit will diminish. The desire to possess great wealth arises because of the power it gives rather than the happiness it secures; but the desire for power, born of aggression, must eventually disappear with the growth of altruistic feelings. If Mr. Ravenstein's figures* are to be trusted, barely two centuries will elapse before the globe is peopled with the six thousand millions it can support, and the condition attained under which the final adjustment of man to his environment must be effected. When this latter is accomplished, complete harmony will reign, and so we arrive at a Socialism, complete and all satisfying, achieved by forces older than humanity itself, and worked out by that Evolution which clasps the Universe in its all-powerful embrace.

Bromley and the Electric Light.—The Bromley Local Board has decided to make application to the Board of Trade for a provisional order to construct works, and to produce, store, supply and sell electricity for light, motive power, and all public and private purposes within its area.

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* "The Man *v.* The State," page 63.

† Mr. Arnold White on "Socialism" in the *Weekly Times* and *Echo*, September 28th, 1890.

* Herbert Spencer's "Principles of Biology," Vol. II., p. 507.

† See Mr. Ravenstein's speech, Conference of Statistical and Geographical Sections, British Association, 1890.

THE ELECTRO-MAGNET.*

By Prof. SILVANUS P. THOMPSON, D.Sc., B A., M.I.E.E.

(*Continued from page* 568.)

Suppose we are working with the magnetisation of our iron pushed to about 16,000 lines to the square centimetre (i.e., about 150 lbs. per square inch, traction), requiring a magnetising force of about H = 50; then, referring to the table, we see that each joint across the iron offers as much reluctance as would an air gap 0·0005 of an inch in thickness, or adds as much reluctance as if an additional layer of iron about $\frac{1}{8}$th of an inch thick had been added. With small magnetising forces the effect of having a cut across the iron with a good surface on it is about the same as though you had introduced a layer of air $\frac{1}{800}$th of an inch thick, or as though you had added to the iron circuit about 1 inch of extra length. With large magnetising forces, however, this disapears, probably because of the attraction of the two surfaces across that cut. The stress in the magnetic circuit, with high magnetic forces running up to 15,000 or 20,000 lines to the square centimetre, will of itself put on a pressure of 130 to 230 lbs. to the square inch, and so these resistances are considerably reduced; they come down, in fact, to about $\frac{1}{10}$th of their initial value. When Ewing specially applied compressing forces, which were as large as 670 lbs. to the square inch, which would of themselves ordinarily, in a continuous piece of iron, have diminished the magnetisability, he found the diminution of the magnetisability of iron itself was nearly compensated for by the better conduction of the cut surface. The old surface, cut and compressed in that way, closes as it were magnetically up—does not act like a cut at all; but at the same time you lose just as much as you gain, because the iron itself becomes less magnetisable.

The above results of Ewing are further represented by the curves of magnetisation drawn in fig. 48. When the faces of a cut were carefully surfaced up to true planes, the disadvantageous effect of the cut was reduced considerably, and, under the application of a heavy external pressure, almost vanished.

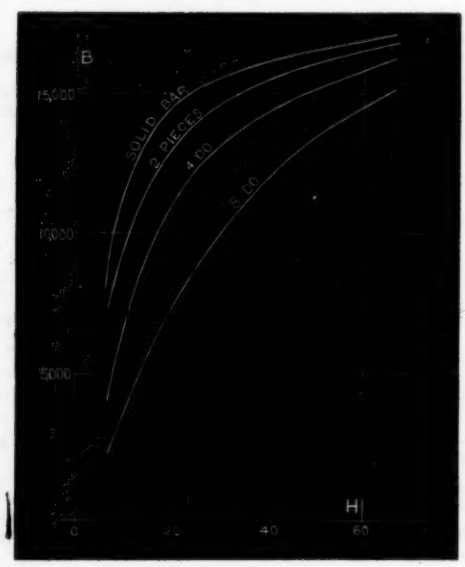

FIG. 48.—EWING'S CURVES FOR EFFECT OF JOINTS.

I have several times referred to experimental results obtained in past years, principally by German and French workers, buried in obscurity in the pages of foreign scientific journals. Too often, indeed, the scattered papers of the German physicists are rendered worthless or unintelligible by reason of the omission of some of the data of the experiments. They give no measurements perhaps of their currents, or they used an uncalibrated galvanometer, or they do not say how many windings they were using in their coils; or perhaps they give their results in some obsolete phraseology. They are extremely addicted to informing you about the "magnetic moments" of their magnets. Now the magnetic moment of an electro-magnet is the one thing that one never wants to know. Indeed, the magnetic moment of a magnet of any kind is a useless piece of information, except in the case of bar magnets of hard steel that are to be used in the determination of the horizontal component of the earth's magnetic force. What one does want to know about an electro-magnet is the number of magnetic lines flowing through its circuit, and this the older researches rarely afford the means of ascertaining. Nevertheless, there are some investigations worthy of study to which time will now only permit me very briefly to allude. These are the researches of Dub on the effect of thickness of armatures, and those of Nicklès and of Du Moncel on the lengths of armatures. Also those of Nicklès on the effect of width between the two limbs of the horse-shoe electro-magnet.

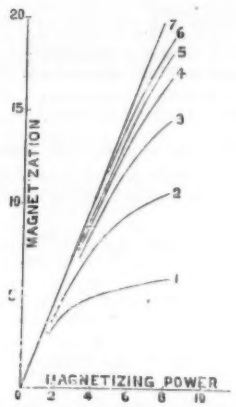

FIG. 49.—VON FEILITZSCH'S CURVES OF MAGNETISATION OF TUBES.

I can only now describe some experiments of Von Feilitzsch upon the vexed question of tubular cores, a matter touched by Sturgeon, Pfaff, Joule, Nicklès, and later by Du Moncel. To examine the question whether the inner part of the iron really helps to carry the magnetism, Von Feilitzsch prepared a set of thin iron tubes which could slide inside one another. They were all 11 centimetres long, and their peripheries varied from 6·12 centimetres to 9·7 centimetres. They could be pushed within a magnetising spiral to which either small or large currents could be applied, and their effect in deflecting a magnetic needle was noted, and balanced by means of a compensating steel magnet, from the position of which the forces were reckoned and the magnetic moments calculated out. As the tubes were of equal lengths, the magnetisation is approximately proportional to the magnetic moment. The outermost tube was first placed in the spiral, and a set of observations made; then the tube of next smaller size was slipped into it and another set of observations made; then a third tube was slipped in until the whole of the seven were in use. Owing to the presence of the outer tube in all the experiments, the reluctance of the air return paths was alike in every case. The curves given in Fig. 49 indicate the results. The lowest curve is that corresponding to the use of the first tube alone. Its form, bending over and becoming nearly horizontal, indicates that with large magnetising power it became nearly saturated. The second curve corresponds to the use of the first tube with the second within it. With greater section of iron saturation sets in at a later stage. Each successive tube adds to the capacity for carrying magnetic lines, the beginning of saturation being scarcely perceptible, even with the highest magnetising power, when all seven tubes were used. All the curves have the same initial slope. This indicates that with small magnetising forces, and when even the least quantity of iron was present, when the iron was far from saturation, the main resistance to magnetisation was that of the air paths, and it was the same whether the total section of iron in use was large or small.

I must leave till my next lecture the rules relating to the determination of the windings of copper wire on the cores.

APPENDIX TO LECTURE II.

CALCULATION OF EXCITATION, LEAKAGE, &c.

Symbols used.

- N = whole number of magnetic lines (C.G.S., definition of magnetic lines, being 1 line per sq. centim. to represent intensity of a magnetic field, such that there is 1 dyne on unit magnetic pole) that pass through the magnetic circuit. Also called the *magnetic flux*.
- B = the number of magnetic lines per square centimetre, in the iron; also called the *induction*, or the internal magnetisation.
- $B_{''}$ = the number of magnetic lines per square inch in the iron.
- H = the magnetic force or intensity of the magnetic field, in terms of the number of magnetic lines to the square centimetre that there would be in air.
- $H_{''}$ = the magnetic force, in terms of the number of magnetic lines that there would be to the square inch, in air.
- μ = the *permeability* of the iron, &c.; that is its magnetic conductivity or multiplying power for magnetic lines.
- A = area of cross section, in square centimetres.
- A'' = area of cross section, in square inches.
- l = length, in centimetres.
- l'' = length, in inches.
- s = number of spirals or turns in the magnetising coil.

* Cantor Lecture. Delivered before the Society of Arts, January 27th, 1890.

i = electric current, expressed in ampères.
v = coefficient of allowance for leakage; being the ratio of the whole magnetic flux to that part of it which is usefully applied. (It is always greater than unity.)

Relations of Units.

1 inch = 2·54 centimetres;
1 centimetre = 0·3937 inch.

1 square inch = 6·45 square centimetres;
1 square centimetre = 0·1550 square inch.

1 cubic inch = 16·39 cubic centimetres;
1 cubic centimetre = 0·0610 cubic inch.

To calculate the value of B *or of* $B_{,,}$ *from the Traction.*

If P denote the pull, and A the area over which it is exerted, the following formula (derived from Maxwell's law, see p. 899) may be used :—

$$B = 4{,}965 \sqrt{\frac{P \text{ kilos.}}{A \text{ sq. cm.}}};$$

$$B = 1{,}316{\cdot}6 \sqrt{\frac{P \text{ lbs.}}{A \text{ sq. in.}}}; \text{ or}$$

$$B_{,,} = 8{,}494 \sqrt{\frac{P \text{ lbs.}}{A \text{ sq. in.}}}.$$

To calculate the requisite cross section of Iron for a given Traction.

Reference to page 896 will show that it is not expedient to attempt to employ tractive forces exceeding 150 lbs. per square inch in magnets whose cores are of soft wrought iron, or exceeding 28 lbs. per square inch in cast iron. Dividing the given load that is to be sustained by the electro-magnet by one or other of these numbers, gives the corresponding requisite sectional area of wrought or cast iron respectively.

To calculate the Permeability from B *or from* $B_{,,}$.

This can only be satisfactorily done by referring to a numerical table (such as Table II. or IV.), or to graphic curves, such as fig. 18, in which are set down the result of measurements made on actual samples of iron of the quality that is to be used. The values of μ for the two specimens of iron to which Table II. refers may be *approximately* calculated as follows :—

$$\text{For annealed wrought iron, } \mu = \frac{17{,}000 - B}{3{\cdot}5};$$

$$\text{For grey cast iron, } \mu = \frac{7{,}000 - B}{3{\cdot}2}.$$

These formulæ must not be used for the wrought iron for tractions that are less than 28 lbs. per square inch, nor for cast iron for tractions less than 2¼ lbs. per square inch.

To calculate the Total Magnetic Flux which a core of given sectional area can conveniently carry.

It has been shown that it is not expedient to push the magnetisation of wrought iron beyond 100,000 lines to the square inch, nor that of cast iron beyond 42,000. These are the highest values that ought to be assumed in designing electro-magnets. The total magnetic flux is calculated by multiplying the figure thus assumed by the number of square inches of sectional area.

To calculate the Magnetising Power requisite to force a given number of Magnetic Lines through a definite Magnetic Reluctance.

Multiply the number which represents the magnetic reluctance by the total number of magnetic lines that are to be forced through it. The product will be the amount of magneto-motive force. If the magnetic reluctance has been expressed on the basis of centimetre measurements, the magneto-motive force, calculated as above, will need to be divided by 1·2566 $\left(i.e., \text{ by } \frac{4\pi}{10}\right)$ to give the number of ampère turns of requisite magnetising power. If, however, the magnetic reluctance has been expressed in the units explained below, based upon inch measures, the magnetising power, calculated by the rule given above, will already be expressed directly in ampère turns.

TO CALCULATE THE MAGNETIC RELUCTANCE OF AN IRON CORE.

(*a.*) *If dimensions are given in centimetres.*—Magnetic reluctance being directly proportional to length, and inversely proportional to sectional area and to permeability, the following is the formula :—

$$\text{Magnetic reluctance} = \frac{l}{A\,\mu};$$

but the value of μ cannot be inserted until one knows how great B is going to be; when reference to Table II. gives μ.

(*b.*) *If dimensions are given in inches.*—In this case we can apply a numerical co-efficient, which takes into account the change of units (2·54), and also, at the same time, includes the operation of dividing the magneto-motive force by $\frac{1}{10}$ths of π (= 1·2566) to reduce it to ampère turns. So the rule becomes

$$\text{Magnetic reluctance} = \frac{l''}{A''\,\mu} \times 0{\cdot}3132.$$

Example.—Find the magnetic reluctance from end to end of a bar of wrought iron 10 inches long, with a cross section of 4 square inches, on the supposition that the magnetic flux through it will amount to 440,000.

To calculate the Total Magnetic Reluctance of a Magnetic Circuit.

This is done by calculating the magnetic reluctances of the separate parts, and adding them together. Account must, however, be taken of leakage; for when the flux divides, part going through an armature, part through a leakage path, the law of shunts comes in, and the nett reluctance of the joint paths is the reciprocal of the sum of their reciprocals. In the simplest case the magnetic circuit consists of 3 parts (1) armature, (2) air in the two gaps, (3) core of the magnet. These three reluctances may be separately written, as in the Table in next column.

If the iron used in armature and core is of the same quality, and magnetised np to the same degree of saturation, μ_1 and μ_2 will be alike. For the air-gaps $\mu = 1$, and therefore is not written in.

If there were no leakage, the total reluctance would simply be the sum of these three terms. But when there is leakage, the total reluctance is reduced.

	For centimetre measure.	For inch measure.
1. Armature ...	$\frac{l_1}{A_1\,\mu_1}$	$\frac{l''_1}{A''_1\,\mu_1} \times 0{\cdot}3132$
2. The Gaps ...	$2\,\frac{l_2}{A_2}$	$2\,\frac{l''_2}{A''_2} \times 0{\cdot}3132$
3. Magnet Core..	$\frac{l_3}{A_3\,\mu_3}$	$\frac{l''_3}{A''_3\,\mu_3} \times 0{\cdot}3132$

To calculate the ampère-turns of Magnetising Power requisite to force the desired Magnetic Flux through the reluctances of the Magnetic Circuit.

(*a.*) *If dimensions are given in centimetres* the rule is :—

Ampère-turns = the magnetic flux, multiplied by the magnetic reluctance of the circuit, divided by $\frac{1}{10}$ths of π (= 1·2566).

Or, in detail, the three separate amounts of ampère-turns required for three principal magnetic reluctances are explained as follows :—

$$\left.\begin{array}{l}\text{Ampère-turns required to drive N lines}\\ \text{through iron of armature ... ...}\end{array}\right\} = N \times \frac{l_1}{A_1\,\mu_1} \div \frac{4\pi}{10},$$

$$\left.\begin{array}{l}\text{Ampère-turns required to drive N lines}\\ \text{through the two gaps .. ..}\end{array}\right\} = N \times \frac{2\,l_2}{A_2} \div \frac{4\pi}{10},$$

$$\left.\begin{array}{l}\text{Ampère-turns required to drive } v\,N\\ \text{lines through the iron of magnet core}\end{array}\right\} = vN \times \frac{l_3}{A_3\,\mu_3} \div \frac{4\pi}{10},$$

And, adding up :—

$$\text{Total ampère-turns required} = \frac{10}{4\pi} N \left\{\frac{l_1}{A_1\,\mu_1} + \frac{2\,l_2}{A_2} + \frac{v\,l_3}{A_3\,\mu_3}\right\},$$

(*b.*) *If dimensions are given in inches*, the rule is :—Ampère-turns = magnetic flux multiplied by the magnetic reluctance of the circuit. Or, in detail :—

$$\left.\begin{array}{l}\text{Ampère-turns required to drive N lines}\\ \text{through iron of armature ... ...}\end{array}\right\} = N \times \frac{l''_1}{A''_1\,\mu_1} \times 0{\cdot}3132,$$

$$\left.\begin{array}{l}\text{Ampère-turns required to drive N lines}\\ \text{through two gaps ... ...}\end{array}\right\} = N \times \frac{2\,l''_2}{A''_2} \times 0{\cdot}3132,$$

$$\left.\begin{array}{l}\text{Ampére-turns required to drive } v\,N \text{ lines}\\ \text{through iron core of magnet ... ...}\end{array}\right\} = vN \times \frac{l''_3}{A''_3\,\mu_3} \times 0{\cdot}3132;$$

And, adding up :—

$$\text{Total ampère turns required} = 0{\cdot}3132\,N \left\{\frac{l''_1}{A''_1\,\mu_1} + \frac{2\,l''_2}{A''_2} + \frac{v\,l''_3}{A''_3\,\mu_3}\right\}.$$

It will be noted that here v, the coefficient of allowance for leakage, has been introduced. This has to be calculated as shown later. In the meantime it may be pointed out that, in designing electro-magnets for any case where v is approximately known beforehand, the calculation may be simplified by taking the sectional area of the magnet core greater than that of the armature in the same proportion. For example, if it were known that the waste lines that leak were going to be equal in number to those that are usefully employed in the armature (here $v = 2$), the iron of the cross might be made of double the section of that of the armature. In this case μ_3 will approximately equal μ_1.

To calculate the Coefficient of Allowance for Leakage, v.

v = total magnetic flux generated in magnet core ÷ useful magnetic flux through armature. The respective useful and waste magnetic fluxes are proportional to the permeances along their respective paths. *Permeance*, or magnetic conductance, is the reciprocal of the *reluctance*, or magnetic resistance. Call useful permeance through armature and gaps u; and the waste permeance in the stray field w; then

$$v = \frac{u + w}{u}$$

is may be estimated by the Table VIII. given on p. 567 (ELEC. REV., November 7th), or other leakage rules, but should be divided by 2 as the average difference of magnetic potential over the leakage surface is only about half that at the end of the poles.

RULES FOR ESTIMATING MAGNETIC LEAKAGE.

(I. to III. Adapted from Prof. Forbes's rules.)

Prop. I. Permeance between two parallel areas facing one another.—Let areas be A_1'' and A_2'' square inches, and distance apart d'' inches, then :—

$$\text{Permeance} = 3{\cdot}193 \times \tfrac{1}{2}\,(A''_1 + A''_2) \div d''.$$

Prop. II. Permeance between two equal adjacent rectangular areas lying in one plane.—Assuming lines of flow to be semicircles, and that distances d''_1 and d''_2 between their nearest and furthest edges respectively are given, also a'' their width along the parallel edge :—

$$\text{Permeance} = 2{\cdot}274 \times a'' \times \log_{10} \frac{d_2''}{d_1''}.$$

Prop. III. Permeance between two equal parallel rectangular areas lying in one plane at some distance apart.—Assume lines of leakage to be quadrants joined by straight lines.

$$\text{Permeance} = 2{\cdot}274 \times a'' \times \log_{10} \left\{ 1 + \frac{\pi\,(d''_2 - d''_1)}{d''_1} \right\}$$

Prop. IV. Permeance between two equal areas at right angles to one another.

Permeance (if air angle is 90°) = double the respective value calculated by II. or III.

Permeance (if air angle is 270°) = 1½ times the respective value calculated by II.

If measures are given in centimetres these rules become the following :—

$$\text{I.} \quad \tfrac{1}{2}\,(A_1 + A_2) \div d\,;$$

$$\text{II.} \quad \frac{a}{\pi} \log_e \frac{d_2}{d_1}\,;$$

$$\text{III.} \quad \frac{a}{\pi} \log_e \left(1 \times \frac{\pi\,(d_2 - d_1)}{d_1} \right).$$

Prop. V. Permeance between two parallel cylinders of indefinite length.

The formula for the reluctance is given on p. 566 (ELEC. REV., November 7th) : the permeance is the reciprocal of it. Calculations are simplified by reference to Table VIII.

(To be continued.)

NEW PATENTS—1890.

16752. "Improvements in electrical switches." T. R. ANDREWS and T. PREECE. Dated October 21.

16792. "An improved arrangement of regulating device for electric arc lamps." A. DE PUYAT. Dated October 21.

16809. "Improvements in electric blank heating and feeding apparatus for forging machines." G. D. BURTON. Dated October 22. (*Complete.*)

16811. "The improvement of switchboards for the regulation and control of electrical currents." P. G. POCHIN. Dated October 22.

16835. "An improved electrical conductor for fitting in mine shafts and underground haulage roads for electrical signalling purposes." W. CAIRNS and A. F. MABON. Dated October 22.

16837. "Improvements in the manufacture, construction, and building up of secondary battery elements, electrodes or plates." J. E. DOUGLASS. Dated October 22.

16889. "Improvements in electromotors." R. KENNEDY. Dated October 23. (*Complete.*)

17018. "Improved joints or connectors for uniting wires or cables, temporarily or otherwise, for electrical or other purposes." W. BISHOP. Dated October 24.

17062. "Improved electric switch." J. P. BAYLY. (Communicated by C. Herrick, United States.) Dated October 25.

17063. "An improved electric lampholder and switch combined." J. P. BAYLY. (Communicated by C. Herrick, United States.) Dated October 25.

17108. "Improvements in dynamo-electric machines." G. PITT. (Communicated by R. Thury, Switzerland.) Dated October 25.

ABSTRACTS OF PUBLISHED SPECIFICATIONS 1889.

13168. "Improvements in means for supporting electric lamps and in conductors therefor." A. MCCANDLISH. Dated August 21. 6d. To a permanent or temporary magnet there is attached an elastic medium, such as springs made of metal or India-rubber, for arresting the vibration; to this elastic medium is fixed or suspended the "electric" lamp. 3 claims.

13510. "Lamp shades or reflectors for electric lamps." W. B. LAWRENCE. Dated August 27. 8d. The inventor takes a glass or other bulb, and beneath the apex or neck removes a lateral section thereof. He then surrounds the lamp with the remainder, thus forming a shade and reflector, and it is attached in the following manner :—The globe fits into a sleeve, which contains light wires. The sleeve in turn fits into a socket, on a bracket to which the light wires are applied, and it is held in position and attached by means of shoulder pins, fitting into a groove in the interior of the socket. 4 claims.

15958. "A method of and appliances for preventing excessive heating or undue expansion of electric mains or service conductors through excess of electricity, and for utilising such excess." F. W. ENGELBACH and E. B. BRIGHT. Dated October 10. 8d. A metallic slide bar, attached to the rod of the governor of the engine driving the dynamo-electric machine, is so arranged that it is lifted or lowered by the rising or falling of the governor. The slide bar is electrically connected to one pole of the dynamo-electric machine and makes contact successively with a series of metallic springs insulated from one another. If the apparatus is used simply to neutralise any excess of electricity in the electric conductors the springs are electrically connected to the other pole of the dynamo machine, but the size of the conductor from each spring is such that each spring acts as a shunt between the two poles of the dynamo-electric machine; thus gradually increasing the proportion of electricity diverted from the electric mains or service conductors as the governor rises. 5 claims.

16537. "Improvements relating to insulators for electric wires and to supports therefor." D. RYLANDS. Dated October 19. 8d. Instead of passing the wire around or on one side of the insulator as heretofore, the inventor arranges the insulator lengthwise in the direction of the wire to be insulated, and passes the said wire through a hole formed in the said insulator. 4 claims.

16978. "Improved arrangement of conductors for electric series traction." J. M. M. MUNRO. Dated October 28. 8d. Relates to the arrangement of conductors for carrying the electricity to the motors of vehicles driven by electricity, the object of which is to provide a system of conductors for series traction which will allow of having greater length of continuous conductors than has hitherto been in practical use. In this system the whole circuit is laid off in a number of sections, which may be equal to the greatest number of cars or trains intended to be run upon it at one time. 6 claims.

17115. "Improvements in electro-magnetic telegraph apparatus." F. X. BACHMANN. Dated October 30. 6d. The inventor provides a core connected to or made in one piece with the two pole pieces. The core is wound with a fine wire. The pole pieces rest upon a metal bar lying parallel with the axis of the core. The armature is pivotted to move in a plane parallel with the axis of the core, and at a point therein equidistant between the two pole-pieces. 3 claims.

17276. "An improved socket and adapter for incandescent electric lamps and other electrical purposes." G. DONOVAN and W. DONOVAN. Dated October 31. 8d. Consists in the construction of an adapter or socket of a form similar to the cap of the ordinary incandescent lamp, which is carried out by forming a cylindrical body having a projecting shoulder of smaller diameter of boxwood, porcelain, or any other suitable insulating material. Upon the said projecting shoulder a small piece of tube of brass or other material is fitted of such a size as to fit into the ordinary lamp holder, pins being arranged on the outside of the said tube, in order to engage as a bayonet joint in the lamp holder in the usual manner. Upon the opposite side of the cylindrical body to that on which the brass tube is fitted, a circular recess or groove is provided either of V or other suitable shape, and from such recess two tubes of brass or other suitable conducting material are led through the body of the socket or adapter, and extend to the same distance as the brass socket tube. Upon the ends of these contact-making tubes suitable contact plates of copper or other equivalent material are arranged. The space within the brass socket tube around the said contact-making tubes is filled with plaster of Paris or other suitable material, so thoroughly insulating the conductors from one another and from the surrounding fittings. 4 claims.

17317. "Improvements in electric measuring and regulating apparatus for use with alternate currents." W. T. GOOLDEN and SYDNEY EVERSHED. Dated November 1. 8d. The object of the invention is to render electro-magnetic measuring instruments, regulating apparatus, and integrating meters, with or without iron or other kindred material as the magnetic medium, suitable for the accurate measurement] and regulation of alternate currents. 6 claims.

17387. "Improvements in electric meters." J. OULTON and J. EDMONDSON. Dated November 2. 8d. Relates mainly to electric meters in which the current to be measured is made to retard or accelerate the vibrations of a pendulum or chronometric balance, the amount of such retardation or acceleration being the measure of the current consumed. 4 claims.

17763. "Improvements in or applicable to electrical switchboards and switches." F. L. RAWSON and W. WHITE. Dated November 7. 8d. The inventors form in an electrical distributing switchboard the connections to the two poles of the main circuit by means of two main bars of metal, which may be castings

arranged so that the connections are all on the surface of the board, the two mains of the dynamo being connected to these two bars at one end of each by means of suitable cable connectors. One of the main bars is made with projections on one side, which projections are bevelled off to allow the brushes as they are turned round to rise to the top of the bar, and so make a good contact for one end of the switch brush. The other contacts of the switch brushes, which may also be castings, are bevelled off where the brushes rise on to them, and are provided with projections to receive the terminal screws under which the ends of the fuses are clamped, the other ends of the fuses being clamped under terminal screws on to suitable plates, at the other end of which plates cable connectors for the external circuits are clamped down with a nut. All the contact plates on the surface of the board are the same height, and are all flat on the top, so that they can be all planted on the board, and filed or planed over at one operation, thus making the production exceedingly cheap and simple. 4 claims.

18343. "Improved safety cut-out apparatus for a network of multiple electrical conductors." SIEMENS BROS. & Co. (Communicated from abroad by the firm of Siemens and Halske, of Berlin.) Dated November 16. 8d. Claim:—In a network of multiple electrical conductors, the use of safety cut-out apparatus connected with all the conductors, and so constructed and arranged that when the current in one of the conductors becomes too strong, it effects automatically the interruption of all the conductors, such apparatus consisting either of an inflammable mass in which the safety fuses of all the conductors are imbedded, or of an electro-magnet included in the circuit of each conductor, the armature of which controls a cut-out switch for all the conductors, or of any equivalent device for carrying out the above-named object, substantially as described.

CORRESPONDENCE.

The British Insulated Wire Company, Limited

I notice in the current issue of your valuable paper, which has just come to hand, a short reference to the "Norwich" cables made in this country by the British Insulated Wire Company, Limited, in which you remark, "There is apparently no attempt to make any test which the merest tyro in a submarine cable factory would know to be necessary." You are good enough to qualify your critique by the term "apparently," and I am glad to be able to inform you that this defect is apparent only and not real.

Of course a new and untested material before coming into practical use requires to be experimented upon exhaustively, but where a given class of cable has been in practical use for some years, doing its duty successfully under various conditions, many of which are most trying, I think you will agree with me that the value of laboratory tests are somewhat discounted as a means of proving the capabilities of manufactures under a given process.

At the same time, as an independent opinion though useful is but that of an individual, and therefore likely to be slightly faddish, it is most satisfactory to have such judgment corroborated by all possible tests, trials, and coincidence of opinion generally, and this, be it noted, is the case on the matter referred to.

The company have been good enough to hand me for perusal several reports by distinguished scientists and well-known practical men, and I find that the figures quoted are those, within a very small percentage, obtained in the tests made by me. On careful consideration of my letter to the British Insulated Wire Company, Limited, you will see that it is only a "memo." prior to furnishing a report which is now completed, and contains all the possible data and results of a series of tests on the "Norwich" telephone and electric light cable. Also I referred to some experiments on "Hygrometric absorption" in my memo., so that the cable has been "submitted to the action of damp, and its insulation has remained unimpaired." Regarding your interpretation of my remark as to maintenance of high insulation at a high temperature, reference might be made to some statements by Mr. David Brooks, in January, 1886, as follows:—

"All of the recognised insulating materials are affected by temperature. The insulating property of gutta-percha is 100 times higher at + 100° F. than at the freezing point." "Textile coverings like cotton, flax, hemp, jute and manilla show entirely different results. These materials in a natural state may be classed as conductors."

The company are in possession of complete and reliable data of a set of tests made in different ways and at different times, and no doubt they will be prepared to furnish you with these at an early date for your complete satisfaction.

Charles H. Yeaman.

Electrical Testing Room, City of Liverpool, *November 8th*, 1890.

Being a subscriber to your valuable journal, and a pretty constant reader, I saw the notice you honoured the British Insulated Wire Company with in your issue of the 7th inst., and have nothing to complain of in your remarks except, perhaps, the concluding sentence, viz., "the practice (so common) of attracting the unsuspecting public by reports which are not worth the paper they are written on, cannot be too severely condemned."

Had it not been that the company must be advertised to comply with the terms of the underwriting letter, the "unsuspecting public" would never have been asked to buy a share, as *every* underwriting contract being by personal friends was a *bonâ fide* purchase and not a speculation.

I had intended, and still intend, sending you fullest details of tests of this make of cable, and hope to do so within the next few days.

R. E. Crompton, Esq., is not acting in the dark, as he was good enough to put some of these cables into service in the early part of this year, and has nothing but praise for them.

My object in troubling you with this letter is to show you that no imposition on the public was designed, or a precedent for a very different policy could readily have been found.

J. B. Atherton.

November 11th, 1890.

Life of Glow Lamps on the Series System.

In the discussion on Mr. Bernstein's Paper on the "Series System," read in the Institution of Electrical Engineers in 1886, Mr. Mordey expressed the opinion that lamps on a circuit of constant current must of necessity be shorter lived than lamps on a parallel circuit, the reason being that the resistance of lamps rises in course of time. If placed in parallel, they will then take less current, give less light, but have a considerable preservative power.

This view appears very plausible, and it will therefore be of interest to many readers to hear that a Bernstein lamp, which was placed in a circuit of constant current of 10 ampères in Niagara-in-London, has been in use more than three years every night except Sundays, and has already lasted more than 10,000 hours. During the present year it has been run 12 hours daily.

The system on which this lamp has been run is known as the Wood's system of arc lighting, and is owned by the Fort Wayne Electric Company, of Indiana.

Frank Lott,
Electrical Engineer in charge,
"Niagara-in-London."

November 7th, 1890.

[A. E. MUIRHEAD.—The telephone receiver you mention is apparently similar to that of Silvanus Thompson, the Stanhope, and others, and also to the one known as the "English Mechanic" receiver. If this is so, we believe it is no infringement of the Bell patent.—EDS. ELEC. REV.]